CBSE & State Boards

UNSOLVED PAPERS

PHYSICS

CHAPTER WISE
& SUB- TOPICWISE

Question Bank

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Class-XII (2023-24)
PHYSICS (THEORY)

Time: 3 hrs **Max. Marks: 70**

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Unit–I	**Electrostatics**	**26**	**16**
	Chapter–1: Electric Charges and Fields		
	Chapter–2: Electrostatic Potential and Capacitance		
Unit-II	**Current Electricity**	**18**	
	Chapter–3: Current Electricity		
Unit-III	**Magnetic Effects of Current and Magnetism**	**25**	**17**
	Chapter–4: Moving Charges and Magnetism		
	Chapter–5: Magnetism and Matter		
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	Chapter–8: Electromagnetic Waves		
Unit-VI	**Optics**	**30**	
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	Chapter–10: Wave Optics		
Unit-VII	**Dual Nature of Radiation and Matter**	**08**	**12**
	Chapter–11: Dual Nature of Radiation and Matter		
Unit-VIII	**Atoms and Nuclei**	**15**	
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	Chapter–13: Nuclei		
Unit-IX	**Electronic Devices**	**10**	**7**
	Chapter–14: Semiconductor Electronics: Materials, Devices and Simple Circuits		
Total		**160**	**70**

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Syllabus

Unit I: Electrostatics

Chapter–1: Electric Charges and Fields

Electric charges, Conservation of charge, Coulomb's law-force between two- point charges, forces between multiple charges; superposition principle and continuous charge distribution.

Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric field.

Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).

Chapter–2: Electrostatic Potential and Capacitance

Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two-point charges and of electric dipole in an electrostatic field.

Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarization,

Capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor (no derivation, formulae only).

Unit II: Current Electricity

Chapter–3: Current Electricity

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, temperature dependence of resistance, Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel, Kirchhoff's rules, Wheatstone bridge.

Unit III: Magnetic Effects of Current and Magnetism

Chapter–4: Moving Charges and Magnetism

Concept of magnetic field, Oersted's experiment.

Biot - Savart law and its application to current carrying circular loop.

Ampere's law and its applications to infinitely long straight wire. Straight solenoid (only qualitative treatment), force on a moving charge in uniform magnetic and electric fields.

Force on a current-carrying conductor in a uniform magnetic field, force between two parallel current-carrying conductors-definition of ampere, torque experienced by a current loop in uniform magnetic field; Current loop as a magnetic dipole and its magnetic dipole moment, moving coil galvanometer- its current sensitivity and conversion to ammeter and voltmeter.

Chapter–5: Magnetism and Matter

Bar magnet, bar magnet as an equivalent solenoid (qualitative treatment only), magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis (qualitative treatment only), torque on a magnetic dipole (bar magnet) in a uniform magnetic field (qualitative treatment only), magnetic field lines.

Magnetic properties of materials- Para-, dia- and ferro - magnetic substances with examples, Magnetization of materials, effect of temperature on magnetic properties.

Unit IV: Electromagnetic Induction and Alternating Currents

Chapter–6: Electromagnetic Induction

Electromagnetic induction; Faraday's laws, induced EMF and current; Lenz's Law, Self and mutual induction.

Chapter–7: Alternating Current

Alternating currents, peak and RMS value of alternating current/voltage; reactance and impedance; LCR series circuit (phasors only), resonance, power in AC circuits, power factor, wattless current, AC generator, Transformer.

Unit V: Electromagnetic waves

Chapter–8: Electromagnetic Waves

Basic idea of displacement current, Electromagnetic waves, their characteristics, their transverse nature (qualitative idea only).

Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Unit VI: Optics

Chapter–9: Ray Optics and Optical Instruments

Ray Optics: Reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and optical fibers, refraction at spherical

surfaces, lenses, thin lens formula, lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism.

Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Chapter–10: Wave Optics

Wave optics: Wave front and Huygen's principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width (No derivation final expression only), coherent sources and sustained interference of light, diffraction due to a single slit, width of central maxima (qualitative treatment only).

Unit VII: Dual Nature of Radiation and Matter

Chapter–11: Dual Nature of Radiation and Matter

Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light.

Experimental study of photoelectric effect Matter waves-wave nature of particles, de-Broglie relation.

Unit VIII: Atoms and Nuclei

Chapter–12: Atoms

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model of hydrogen atom, Expression for radius of nth possible orbit, velocity and energy of electron in nth orbit, hydrogen line spectra (qualitative treatment only).

Chapter–13: Nuclei

Composition and size of nucleus, nuclear force Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion.

Unit IX: Electronic Devices

Chapter–14: Semiconductor Electronics: Materials, Devices and Simple Circuits

Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Intrinsic and extrinsic semiconductors- p and n type, p-n junction

Semiconductor diode - I-V characteristics in forward and reverse bias, application of junction diode -diode as a rectifier.

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01. Electric Charge and Fields

I. Electric Charge and Conductors and insulators

Section-A (Multiple Choice Questions)

1. S.I. unit of linear density of charge is
(a) cm^{-1} (b) cm^{-2}
(c) cm (d) cm^2
Bihar Board-2021

Ans. (a) :

2. A change 'q' placed at the centre on the line joining two charges 'Q' will be in equilibrium if 'q' will be equal to
(a) $\frac{Q}{2}$ (b) $-\frac{Q}{4}$
(c) $-4Q$ (d) $+\frac{Q}{4}$
Bihar Board-2023

Ans. (b) :

3. A glass rod rubbed with a silk cloth acquires a charge of $+19.2 \times 10^{-18}$ C, then
(a) number of protons gained by the glass rod is 120
(b) number of electrons lost by the glass rod is 12
(c) number of electrons lost by the glass rod is 120
(d) number of electrons gained by the silk cloth is 120
Meghalaya Board-2014

Ans. (b) :

4. The expression for capacity of a spherical conductor is:
(a) $C = \frac{1}{4\pi \in_0 R}$ (b) $C = 4\pi \in_0 R$
(c) $C = 4\pi \in_0 R^2$ (d) $C = 4\pi$
MP Board-2013

Ans. (b) :

5. A moving charge produces:
(a) only electric field
(b) only magnetic field
(c) both electric and magnetic fields
(d) neither the electric field nor the magnetic field
MP Board-2013

Ans. (c) :

6. The minimum charge on a proton is :
(a) 1.6×10^{-6}C (b) 1.6×10^{-10}C
(c) 1.6×10^{-19}C (d) 6.02×10^{23}C
MP Board-2022
Haryana Board-2018
Haryana Board-2016

Ans. (c) :

7. (a) In a charge system , charges q_1 and q_2 are at some distance. Another charge q_3 is brought near to this system. force offered by charge q_1 on q_2 will.
(a) increase
(b) decrease
(c) remain unchanged
(d) depend on the nature of charge q_3
UP Board-2021

Ans. (c) :

8. The charge on an electron is:
(a) 0 C (b) 1 C
(c) -2.6×10^{-19}C (d) -1.6×10^{-19}C
Haryana Board-2018

Ans. (d) :

9. The charge on an atom is:
(a) 0C (b) 1 C
(c) $1.6 \times 10^{+19}$ C (d) 1.6×10^{-19} C
Haryana Board-2018

Ans. (a) :

10. (i) SI unit of electric charge is:
(a) Ampere (b) Coulomb
(c) Volt (d) None
Haryana Board-2017

Ans. (b) :

11. The charge equivalent to 6×10^{18} electrons is —— .
(a) –1C (b) 1C
(c) 1mC (d) –1mC
Gujarat Board- March, 2020

Ans. (b) :

12. How much charge should be placed on a spherical shell of radius 25 cm to have a surface charge density of $\frac{3}{\pi}$ C/m²?
(a) 0.57 c (b) 0.75 c
(c) 0.25 c (d) 0.5 c
Gujarat Board-2023

Ans. (b) :

13. A plastic rod rubbed with wool is found to have a negative charge of 8×10^{-7} C. The no. of electrons transferred (from which to which?) is. ___.
(a) 5×10^{10} , from wool to plastic rod
(b) 5×10^{11} , from plastic rod to wool
(c) 5×10^{12} , from plastic rod to wool
(d) 5×10^{12} ,from wool to plastic rod
Gujarat Board-2023

Ans. (b) :

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14. A positively charged body has

(a) excess of electrons (b) deficit of electrons
(c) excess of protons (d) deficit of protons

Jharkhand Board-2020

Ans. (b) :

15. A body has a positive charge of 8×10^{-19} C. It has

(a) an excess of 5 electrons
(b) a deficiency of 5 electrons
(c) an excess of 8 electrons
(d) a deficiency of 8 electrons

ISC-2012

Ans. (b) :

16. When 10^{20} electrons are removed from the surface of a neutral metal plate, the electric charge on it (in coulomb is)

(a) +16 (b) –1.6
(c) 10^{-19} (d) 10^{19}

Meghalaya Board-2017

Ans. (a) :

17. Unit of surface charge density (σ) is ——.

(a) $\frac{C}{m^3}$ (b) $\frac{C}{m^2}$
(c) $\frac{C}{m}$ (d) Cm

Gujarat Board- March, 2020

Ans. (b) :

Section-B (Very Short Answer)

18. What is volume charge density? Write its SI unit.

Chhattisgarh Board-2020
Karnataka Board-March, 2014, 2015

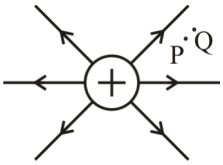
19. There is 2.4×10^{-18} coulomb positive charge on a conductor. State how many electrons are decreased or increased on the conductor.

UP Board-2022

20. Charge resides only on the outer surface of a charged conductor. (True / False)

J&K Board-2022

21. The figure shows the field lines of a positive charge. Is the work done by the field is moving a small positive charge from Q to P positive or negative?



Foreign-2014

22. Does the charge given to a metallic sphere depend on whether it is hollow or solid?
Give reason for your answer.

Delhi-2017

23. Write any two basic properties of charge.

Karnataka Board-March, 2019

24. A sphere of radius 5 cm has a charge of 31.41 μC. Calculate the surface density of charge.

Bihar Board-2023

25. What is quantisation of charge?

J&K Board-2023
Assam Board-2015

26. What is the value of fundamental charge?

MP Board-2019

27. What is a fundamental charge? Write its value.

MP Board-2023

28. Calculate the charge on nucleus $_7N^{14}$ in coulomb.

UP Board-2023

29. Why can the interior of a conductor have no excess charge in the static situation?

CBSE-2019

30. Why is the direction of the electric field due to a charged conducting sphere at any point perpendicular to its surface?

CBSE-2019

31. Two metallic spheres A and B kept on insulating stands are in contact with each other. A positively charged rod P is brought near the sphere A as shown in the figure. The two spheres are separated from each other, and the rod P is removed. What will be the nature of charges on spheres A and B ?

A metal sphere is kept on an insulating stand. A negatively charged rod is brought near it, then the sphere is earthed as shown. On removing the earthing, and taking the negatively charged rod away, what will be the nature of charge on the sphere? Give reason for your answer.

CBSE-2019

32. Draw the equipotential surfaces due to an isolated point charge.

CBSE-2019

33. What do you mean by conservation of electric charge?

J&K Board-2018

34. Why do two parallel conductors carrying current exert force on each other ?

J&K Board-2016, 2017, 2018, 2023

Search On TG: @apna_pdf

35. The size of soap bubble increases on charging. Why? Write the relation between charge density and radius of bubble.

Rajasthan Board-2011

36. Derive an expression for electric potential due to a point charge. How do electric potential vary with distance 'r' for a point charge ?

Nagaland Board-2020

37. Define surface charge density and volume charge density of an electric charge. Also state its unit.

Gujarat Board- March, 2019

38. Why is it safer to be inside a car than standing under a tree during lightning?

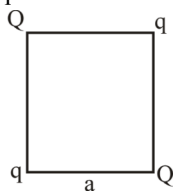
Tamil Nadu Board-2017

Section-C (Short Answer)

39. Two small conducting balls A and B of radius r_1 and r_2 have charges q_1 and q_2 respectively. They are connected by a wire. Obtain the expression for charges on A and B, in equilibrium.

CBSE-2023

40. Four point charges Q, q, Q and q are placed at the corners of a square of side a as show in figure.



Find the

(a) resultant electric force on a charge Q and

(b) potential energy of this system.

CBSE-2019

41. Give three properties of electric charge.

Karnataka Board-July, 2014, 2018

42. Two spheres of radii 3cm and 8cm are charged with 4×10^{-9}C and 16×10^{-9}C of electricity respectively. If they are joined by a wire, how much charge will flow from one to the other sphere?

Assam Board-2016

43. State and explain the law of conservation of charge.

J&K Board-2017, 2016

Section-D (Long Answer)

44. **Two point charges $q_A = 5\mu C$ and $q_B = -5\mu C$ are located at A and B separated by 0.2 m in vacuum.**

(a) What is the electric field at the mid point O of the line joining the charges?

(b) If a negative test charge of magnitude 2nC is placed at O, what is the force experienced by the test charge?

Karnataka Board-March, 2020

45. Three charges each equal to +4nC are placed at the three corners of a square of side 2cm. Find the electric field at the fourth corner.

Karnataka Board-July, 2018

46. Two charges 3×10^{-8} C & -2×10^{-8} C are located 15 cm apart At what point on the line joining the two charges is the electric potential zero? Take the potential infinity to be 0.

Karnataka Board-July, 2014

47. (c) Explain the meaning of the statement "electric charge is quantised".

Meghalaya Board-2021

II. Coulomb's Law, and Force between Multiple Charges

Section-A (Multiple Choice Questions)

48. **The law, governing the force acting between two electric charges know as**

(a) Ampere's law (b) Ohm's law
(c) Faraday's law (d) Coulomb's law

Bihar Board-2023

Ans. (d) :

49. **The electrostatic force between two charge distance r apart in vacuum is F. The force between the same charges distance r/2 apart in a medium of dielectric constant 2 is**

(a) F / 2 (b) 2F
(c) F/4 (d) 4F

Odisha Board-2020

Ans. (b) :

50. **The law regarding the electrostatic force between two point charges is**

(a) Ampere's law (b) Gauss's law
(c) Coulomb's law (d) Faraday's law

Odisha Board-2022

Ans. (c) :

51. **Unit of surface charge density is.**

(a) Coulomb/metre^2 (b) Newton/metre
(c) Coulomb/Volt (d) Coulomb-metre

Bihar Board-2019

Ans. (a) :

52. **Electric force between two charged particles situated at any distance is F newton. If the distance between two becomes half then the value of electric force will be**

(a) 4F (b) 2F
(c) $\frac{1}{4}$F (d) $\frac{1}{2}$F

Bihar Board-2022

Ans. (a) :

53. **S.I. unit of permittivity is**

(a) $N^{-1} C^{-1} m^2$ (b) $NC^2 m^2$
(c) $NC^{-2} m^2$ (d) $C^2 N^{-1} m^{-2}$

Bihar Board-2023

Tamil Nadu Board-March, 2011, 2016

Ans. (d) :

Search On TG: @apna_pdf

54. The force between two equal point charges separated by a certain distance is F. If the distance between them is doubled and their individual charge are also doubled, then the force between them is

(a) F (b) 2F
(c) F/2 (d) F/4

Meghalaya Board-2019

Ans. (a) :

55. The electrostatic force between two electrons separated by a distance of 4.8×10^{-15} m in vacuum is

(a) 9×10^{9} N (b) 4.8 N
(c) 10 N (d) 1.6×10^{-19} N

Meghalaya Board-2013

Ans. (c) :

56. Electric force between two stationary charges becomes $1/10^{th}$ when space between them is filled by a dielectric medium. Relative permittivity of the medium is :

(a) 1 (b) 10
(c) 100 (d) 1.1

NIOS-2018

Ans. (b) :

57. At which point, the intensity of electric field will be proportional to r^{o} among the following?

(a) Point charge
(b) Electric dipole
(c) Infinite plane sheet of charge
(d) Linearly charged wire.

UP Board-2019

Ans. (d) :

58. Relative permittivity of water is 81. If ε_w and ε_0 are permittivities of water and vacuum respectively, then

(a) $\varepsilon_0 = 9\varepsilon_w$ (b) $\varepsilon_0 = 81\varepsilon_w$
(c) $\varepsilon_w = 9\varepsilon_0$ (d) $\varepsilon_w = 81\varepsilon_0$

ISC-2013

Ans. (d) :

59. An isolated point charge particle produces an electric field $\vec{E}$ at a point 3 m away from it. The distance of the point at which the field is $\frac{\vec{E}}{4}$ will be

(a) 2 m (b) 3 m (c) 4 m (d) 6 m

CBSE-2023

Ans. (d) :

60. The SI value of permittivity of free space or vacuum is

(a) $9\times10^{9}\ Nm^2C^{-2}$ (b) $9\times10^{-9}Nm^2C^{-2}$
(c) $8.854\times10^{-12}C^2N^{-1}m^{-2}$
(d) $8.854\times10^{+12}C^2N^{-1}m^{-2}$

Rajasthan Board-2023

Ans. (c) :

61. Two charges +1μc and +8μc are situated at a distance in air. The ratio of forces acting on them is:

(a) 1 : 8 (b) 8 : 1
(c) 1 : 1 (d) 1 : 16

Haryana Board-2022

Ans. (c) :

62. When the distance between two charged particles is doubled, the force between them becomes:

(a) one-fourth (b) half
(c) double (d) four times

Haryana Board-2018

Ans. (d) :

63. When the distance between two charged particles is made one-fourth, the force between them becomes:

(a) one-fourth (b) one-third
(c) half (d) sixteen times

Haryana Board-2018

Ans. (d) :

64. _____C is the number of positive charge for cup having 180g water.

(a) 1.34×10^{6} (b) 0.963×10^{7}
(c) 1.34×10^{7} (d) 0.963×10^{6}

Gujarat Board- August, 2020

Ans. (b) :

65. The Coulombian repulsive force between two alpha particles kept at a distance of 3 cm in air is ____ N.

(a) 1.024×10^{-27} (b) 1.024×10^{-25}
(c) 1.024×10^{-24} (d) 1.024×10^{-23}

Gujarat Board-2023

Ans. (d) :

66. The number of electrons for two coulombs of charge is

(a) 1.25×10^{18} (b) 1.25×10^{19}
(c) 1.25×10^{21} (d) 1.25×10^{23}

Jharkhand Board-2023

Ans. (b) :

67. Two point charges of + 3 μC and + 4 μC repel each other with a force of 10 N. If each is given an additional charge of –6 μC, then the new force is

(a) 2 N (b) 4 N
(c) 5 N (d) 7.5 N

Jharkhand Board-2019

Ans. (c) :

68. The electrostatic force between two point charges kept at a distance 'd' apart, in a medium, $\varepsilon_r = 6$, is 0.3 N. The force between them at the same separation in vacuum is :

(a) 20 N (b) 0.5 N
(c) 1.8 N (d) 2 N

Tamil Nadu Board-September, 2016

Ans. (c) :

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69. Point charges q_1 and q_2 are placed in air at a distance 'r'. The ratio of the force on charge q_1 by charge q_2 and force on charge q_2 by charge q_1 is :

(a) $\frac{q_1}{q_2}$ (b) $\frac{q_2}{q_1}$

(c) 1 (d) $\left(\frac{q_1}{q_2}\right)^2$

Tamil Nadu Board-2017

Ans. (c) :

Section-B (Very Short Answer)

70. Define the linear charge density, surface charge density. Also give their units.

Gujarat Board- May, 2021

71. State and explain Coulomb's law in electrostatics.

Karnataka Board-March, 2014, 2020
Bihar Boar-2015

72. Write coulomb's law in vector form. Explain the terms.

Gujarat Board-July, 2022
Karnataka Board-March, 2015
Assam Board-2014
ISC-2008

73. What is the nature of force between two parallel conductors carrying currents in the same direction?

Karnataka Board-March, 2014

74. Two point charges + 9e and +e are located at a distance of 16 cm from each other. Where should a charge q be placed between them so that it is in equilibrium?

Uttarakhand Board-2023

75. Give Coulomb's law about the force between two point charges.

Uttarakhand Board-2019

76. State and explain Coloumb's inverse square law in electricity.

AP Board-2023

77. Calculate the force between two small charged spheres having charges of $+1 \times 10^{-7}$ C and -1×10^{-7} C placed 30 cm apart in air.

(b) (i) Name the two forces with their nature acting between two protons.

Assam Board-2023

78. (a) We hear a crackle when we take off our synthetic cloths or sweater particularly in dry season. It happens because of_____.

(b) The mathematical expression given below is known as _____ principle.

$$\vec{F}_1 = \frac{q_1}{4\pi\varepsilon_0}\sum_{i=2}^{n}\frac{q_i}{r_{1i}^2}\hat{r}_{1i}$$

Assam Board-2023

79. Three electric point charges q_0, q_1, and q_2 are at distances $\vec{r}_0$, $\vec{r}_1$ and $\vec{r}_2$ respectively with respect to same origin. What is the force on charge q_0 in the field of charges q_1 and q_2?

Assam Board-2017

80. Fill in the blanks:
"The force between two point charges is directly proportional to the product of ..... and inversely proportional to the ..... of the distance between them."

Kerala Board-2021

81. What is the force between two small charged spheres having charges of 2×10^{-7} and 3×10^{7} C placed 30 cm apart in air?

MP Board-2021

82. Write the nature of the force acting between two point charges q_1 and q_2 if $q_1q_2 < 0$.

Chhattisgarh Board-2023

83. A charge Q is placed at the centre of the line joining two equal charges q and q. Calculate the value of Q when the system of three charges are in equilibrium.

UP Board-2018

84. Explain the statement, relative permittivity of water is 81.

ISC-2009

85. Can 8.6×10^{-19} coulomb of charge be given to a conductor? Explain.

ISC-2006

86. Two identical conducting balls A and B have charges – Q and + 3Q respectively. They are brought in contact with each other and then separated by a distance d apart. Find the nature of the Coulomb force between them.

CBSE-2019

87. Five point charges, each of charge + q are placed on five vertices of a regular hexagon of side 'l'. Find the magnitude of the resultant force on a charge – q placed at the centre of the hexagon.

CBSE-2019

88. What is the force between two small charged spheres having charges

2×10^{-7}C and 3×10^{-7}C placed 30 cm apart in air?

Gujarat Board- August, 2020

89. Deduce the expression for the electric field E due to a system of two charges q_1 and q_2 with position vectors r_1 and r_2 at a point r with respect to common origin.

CBSE Delhi-2010C

90. Two identical metallic spherical shells A and B having charges +4Q and –10Q are kept a certain distance apart. A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B, then spheres A and B are brought in contact and then separated. Find the charge on the spheres A and B.

CBSE All India-2011C

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91. Plot a graph showing the variation of Coulomb force (F) versus $1/r^2$, where r is the distance between the two charges of each pair of charges (1 μC, 2μC) and (1 μC, –3μC). Interpret the graphs obtained.

CBSE All India-2011C

92. Two concentric metallic spherical shells of radii R and 2R are given charge Q_1 and Q_2 respectively. The surface charge densities on the outer surfaces of the shells are equal Determine the ratio $Q_1 : Q_2$.

CBSE Foreign-2014

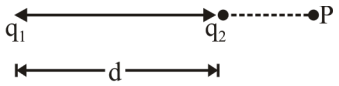
93. Point out whether the following statement is right or wrong.
The mutual forces between two charges not get affected by the presence of other charges.

CBSE All India-2010

94. The point charges having equal charges separated by 1m distance experience a force of 8N. What will be the force experienced by them, if they are held in water at the same distance?
(Given, $K_{water} = 80$)

CBSE All India-2010C

95. Two point charges q_1 and q_2 are placed at a distance d apart as shown in the figure. The electric field intensity is zero at the point P on the line joining them as shown. Write two conclusions that you can draw from this.



CBSE Delhi-2014 C

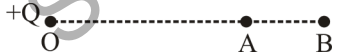
96. Two equal balls having equal positive charge q coulombs are suspended by two insulating strings of equal length. What would be the effect on the force when a plastic sheet is inserted between the two?

CBSE All India-2014

97. An infinite line charge produces a field of 9×10^4 NC^{-1} at a distance of 2 cm. Calculate the linear charge density.

Tamil Nadu Board-September, 2016

98. A point charge +Q is placed at point O as shown in the figure. Is the potential difference $(V_A - V_B)$ positive, negative or zero?



CBSE Delhi-2011, 2016
CBSE Foreign-2016

Section-C (Short Answer)

99. Calculate the magnitude of electrostatic force between a proton and an electron separated by a distance $0.5\,\mathring{A}$. Given that magnitude of charge of proton and electron to be 1.6×10^{-19} C each and $\frac{1}{4\pi\varepsilon_0} = 9\times10^9\,N\text{-}m^2.C^{-2}$.

Assam Board-2015

100. State Coulomb's law for force between stationary charges. Write its vector form and hence define one coulomb of charge in terms of force. What are the SI units of k (constant of proportionality) in the expression for Coulomb's law?

NIOS-2012

101. What are three basic properties of charges? State Coulomb's law of charges. Define the SI unit of charge with its help in terms of force. How many electronic charges are contained in this unit?

NIOS-2014

102. Two point charges + 9e and +e are at a distance 'a' apart. For the equilibrium position, where would a third point charge 'q' be placed on the line joining the two charges?

UP Board-2022

103. Two point charges of + 1.5 μ C and + 2.5 μ C are placed 30 cm apart.
Calculate the magnitude of electric potential and electric field at the mid-point of the line joining the two charges.

Nagaland Board-2018

104. Obtain an expression for the electrostatic potential energy of a system of two point charges.

Nagaland Board-2017

Section-D (Case-Based Questions)

105. Two point charges of + 1 μC and +4 μC are kept 30 cm apart. How far from the +1 μC charge on the line joining the two charges, will the net electric field be zero?

CBSE-2020

Section-E (Long Answer)

106. State and explain Coulomb's law in vector form: Hence defines unit charge.

J&K Board-2021

107. ABCD is square of side 1m. Charges of + 3nC, - 5nC and + 3Nc are placed at the corners A, B and C respectively. Calculate the work done transferring a charge of 12 μC from D to the point of intersection of the diagonals?

Karnataka Board-July, 2019

108. Charges of 2μC, 4μC and 6μC are placed at corners A, B and C respectively of a square ABCD of side x metre. Find, what charge must be placed at the fourth corner so that the total potential at the center of the square is zero.

Karnataka Board-July, 2016

109. ABCD is square of side 2m. Charges of 5nC, + 10nC and –5nC are placed at corners A, B and C respectively. What is the work done in transferring a charge of 5nC from 'D' to the point of intersection of the diagonals?

Karnataka Board-July, 2015

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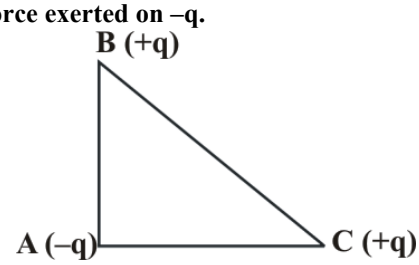
110. (a)State Coulomb's law in electrostatics. Write it in its vector form. What is the importance of expressing it in vector form?

(b)Point charges each of magnitude q are placed at the three corners of a right-angled triangle BAC as shown in the figure, where AB = AC. Find the magnitude and direction of the force exerted on –q.



NIOS-2013

111. Two charges A (charge q) and B (charge 2q) are located at points (0, 0) and (a, a) respectively. Let $\hat{i}$ and $\hat{j}$ be the unit vectors along x-axis and y-axis respectively. Find the force exerted by A on B, in terms of $\hat{i}$ and $\hat{j}$

CBSE-2023

118. (a). (i) State Coulomb's law in electrostatics and write it in vector form, for two charges.

CBSE-2023

112. (a) Write expression for electric field intensity due to a point charge at distance r from it.

(b) What are electric lines of force? Give their main properties.

Haryana Board-2016

113. State Coulomb's law, explain its vector form and define S.I unit of electric charge. State two limitations of Coulomb's law.

Punjab Board-2018

III. Electric Field, Electric Flux and Electric Field Lines

Section-A (Multiple Choice Questions)

114. An electric dipole consisting of charges + q and – q separated by a distance r, is kept symmetrically at the centre of an imaginary sphere of radius R (> r). Another point charge Q is also kept at the centre of the sphere. The net electric flux coming out of the sphere will be

(a) $\frac{-(2q+Q)}{4\pi\varepsilon_0}$ (b) $\frac{Q}{\varepsilon_0}$

(c) $\frac{2q+Q}{\varepsilon_0}$ (d) $\frac{-Q}{\varepsilon_0}$

CBSE-2020

Ans. (b) :

115. Which of the following is correct for electric flux in S.I. unit over a closed spherical surface having charge (Q – q) inside it ?

(a) $\frac{Q-q}{\in_0}$ (b) $(Q-q)\in_0$

(c) $\frac{\in_0}{(Q-q)}$ (d) $\frac{1}{4\pi\in_0}(Q-q)$

Bihar Board-2021

Ans. (a) :

116. Electric field lines provide information about

(a) field strength (b) direction

(c) nature of charge (d) all of these

Bihar Board-2023

Ans. (d) :

117. The force, acting on per unit charge is called

(a) Electric current (b) Electric potential

(c) Electric field (d) Electric space

Bihar Board-2023

Ans. (c) :

118. The total electric flux coming out from stationary unit positive charge in air is

(a) $\in_0$ (b) $(\in_0)^{-1}$

(c) $4\pi\in_0$ (d) $(4\pi\in_0)^{-1}$

Bihar Board-2023

Ans. (b) :

119. Find out the incorrect options from the following:

(a) Inside a conductor, electrotatic field can never be zero.

(b) At the surface of a charged conductor, electrostatic field must be normal to the surface at every point.

(c) The interior of a conductor can have excess charge in the static situation.

Assam Board-2023

Ans. (b) :

120. A charge q is enclosed in a cube. What is the electric flux through any of its two faces?

(a) $\frac{q}{3\varepsilon_o}$ (b) $\frac{q}{4\varepsilon_o}$

(c) $\frac{q}{12\varepsilon_o}$ (d) $\frac{q}{8\varepsilon_o}$

Meghalaya Board-2017

Ans. (c) :

121. Which graph best represents the variation of electric field intensity as a function of distance from the centre of a uniformly charged spherical shell of radius R?

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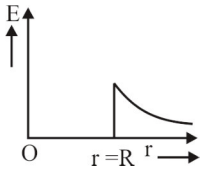
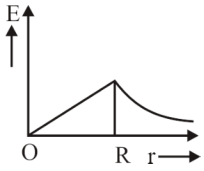
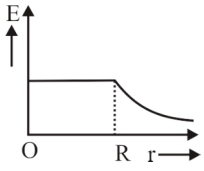
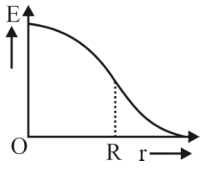
(a) 

(b) 

(c) 

(d) 

Meghalaya Board-2014

Ans. (a) :

122. The intensity of electric field E due to charge Q at distance r:

(a) $E \propto r$ (b) $E \propto \frac{1}{r^2}$

(c) $E \propto \frac{1}{r}$ (d) $E \propto \frac{1}{r^3}$

MP Board-2013

Ans. (b) :

123. The unit of electric flux is

(a) newton/coulomb (b) volt × metre

(c) volt/metre (d) $\frac{\text{newton} \times \text{metre}}{\text{coulomb}}$

UP Board-2018, 2020

Ans. (b) :

124. A charge Q is placed at the centre of a cube. The electric flux through one if its face is

(a) $\frac{Q}{\varepsilon_0}$ (b) $\frac{Q}{6\varepsilon_0}$

(c) $\frac{Q}{8\varepsilon_0}$ (d) $\frac{Q}{3\varepsilon_0}$

CBSE-2023

Ans. (b) :

125. An infinitely long uniformly charged wire produces an electric field of 18×10^4 NC^{-1} at a distance of 1.0 cm. The linear charge density on the wire is-

(a) 1.12×10^{-14} Cm^{-1} (b) 3.08×10^{-15} Cm^{-1}

(c) 1.0×10^{-9} Cm^{-1} (d) 1.0×10^{-7} Cm^{-1}

CBSE-2023

Ans. (d) :

126. An electron experiences a force $(1.6 \times 10^{-16}$ N) $\hat{i}$ in an electric field $\vec{E}$. The electric field $\vec{E}$ is:

(a) $\left(1.0 \times 10^3 \frac{N}{C}\right)\hat{i}$ (b) $-\left(1.0 \times 10^3 \frac{N}{C}\right)\hat{i}$

(c) $\left(1.0 \times 10^{-3} \frac{N}{C}\right)\hat{i}$ (d) $-\left(1.0 \times 10^{-3} \frac{N}{C}\right)\hat{i}$

CBSE-2023

Ans. (b) :

127. The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C. From the same charged object the electric field of magnitude, $16\frac{N}{C}$ will be at a distance of

(a) 1m (b) 2m

(c) 3m (d) 6m

CBSE-2023

Ans. (c) :

128. The electric flux through a closed Gaussian surface depends upon

(a) Net charge enclosed and permittivity of the medium

(b) Net charge enclosed, permittivity of the medium and the size of the Gaussian surface

(c) Net charge enclosed only

(d) Permittivity of the medium only

CBSE-2020

Ans. (a) :

129. The electric flux emerging out from 1 C charge is

(a) $\frac{1}{\varepsilon_0}$ (b) 4π

(c) $\frac{4\pi}{\varepsilon_0}$ (d) ε_0

CBSE-2020

Ans. (c) :

130. If the net electric flux through a closed surface is zero, then we can infer

(a) no net charge is enclosed by the surface.

(b) uniform electric field exists within the surface

(c) electric potential varies from point to point inside the surface

(d) charge is present inside the surface.

CBSE-2020

Ans. (a) :

131. The SI unit of electric flux is-

(a) $NC^{-1}m^2$ (b) $NC^{-1}m^{-2}$

(c) $N^{-1}C^{-1}m^{-2}$ (d) $N^{-1}C^1m^2$

Rajasthan Board-2022

Ans. (a) :

Search On TG: @apna_pdf

132. There exist an electric field of 100 N/C along Z-direction. The flux passing through a square of 10 cm sides placed on XY plane inside the electric field is ————.

(a) 10 Vm (b) 2.0 Vm
(c) 1.0 Nm^2/c (d) 4.0Nm^2/c

Gujarat Board- May, 2021

Ans. (c) :

133. The number of electric field lines emerged out from 1C charge is ———.
($\varepsilon 0 = 8.85\times10^{-12}$ MKS)

(a) 1.13×10^{11} (b) 8.85×10^{2}
(c) 9×10^{9} (d) infinite

Gujarat Board- May, 2021

Ans. (d) :

134. Two metallic spheres of radii R_1 and R_2 are charged. Now they are brought into contact with each other with a conducting wire and then are separated. If the electric fields on their surfaces are E_1 and E_2 respectively $\frac{E_1}{E_2}$ = ...

(a) $\frac{R_1}{R_2}$ (b) $\frac{R_2}{R_1}$
(c) $\frac{R_2^2}{R_1^2}$ (d) $\frac{R_1^2}{R_2^2}$

Gujarat Board- March, 2019

Ans. (b) :

135. The dimensional formula of electric flux is ___.

(a) $M^1L^{-3}T^{-3}A^{-1}$ (b) $M^1L^3T^{-3}A^{-1}$
(c) $M^{-1}L^3T^{-3}A^{-1}$ (d) $M^1L^3T^3A^{-1}$

Gujarat Board-, 2022, 2023

Ans. (b) :

136. The number of electric field lines coming out of charge _____, kept in a vacuum is 1.13×10^{11} ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2N^{-1}m^{-2}$)

(a) 2 C (b) 1 mC
(c) 2 mC (d) 1 C

Gujarat Board-March, 2022

Ans. (d) :

137. An electric field line is a curve drawn in such a way that the tangent drawn at any point on the curve gives _____ at that point.

(a) Magnitude of the electric field
(b) Direction of the electric field
(c) both magnitude and direction of electric field
(d) None of the given choices

Gujarat Board-March, 2022

Ans. (b) :

138. If σ is the surface charge density and ε_0 is the permittivity of free space. Then the magnitude of the electric field at the surface of a charged conductor is _____.

(a) $\frac{\sigma}{\varepsilon_0}$ (b) $\frac{2\sigma}{\varepsilon_0}$
(c) $\frac{\sigma}{2\varepsilon_0}$ (d) $\frac{5\sigma}{3\varepsilon_0}$

Gujarat Board- July, 2022

Ans. (c) :

139. Which one of the following property is not true for electric field lines?

(a) Electric field lines can be taken to be continuous curves without any breaks
(b) Two field lines can never cross each other
(c) Electric field lines form closed loops
(d) The tangent drawn at any point of the field lines represents direction of $\overline{E}$

Gujarat Board- July, 2022

Ans. (a) :

140. Electric field due to a uniformly charged infinite plane sheet at a distance r _____.

(a) is proportional to r
(b) is proportional to $\frac{1}{r^2}$
(c) is proportional to r^2
(d) does not depend on r

Gujarat Board- July, 2022

Ans. (d) :

141. Dimensional formula of $\in_0$ is

(a) $\left[M^1L^2T^{-4}A^{-2}\right]$ (b) $\left[M^{-1}L^{-3}T^4A^2\right]$
(c) $\left[M^1L^3T^{-4}A^{-2}\right]$ (d) $\left[M^{-1}L^{-2}T^4A^2\right]$

Jharkhand Board-2023

Ans. (b) :

142. The electric field at a point outside the plates of two oppositely charged plane sheets of charge density ' σ' is:

(a) $\frac{\sigma}{\in_0}$ (b) $\frac{+\sigma}{2\in_0}$
(c) Zero (d) $\frac{-\sigma}{2\in_0}$

Tamil Nadu Board-2018

Ans. (c) :

143. Two point charges + 4q and + q are placed 30 cm apart. At what point on the line joining them the electric field is zero?

(a) 15 cm from the charge + q
(b) 7.5 cm from the charge + q
(c) 20 cm from the charge + 4q
(d) 5 cm from the charge + q

Tamil Nadu Board-September, 2016

Ans. (c) :

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144. Electric field intensity is 400 Vm^{-1} at a distance of 2m from a point charge. It will be 100 vm^{-1} at distance:

(a) 50 cm (b) 4 cm
(c) 4 m (d) 1.5 m

Tamil Nadu Board-2015

Ans. (c) :

145. The unit of the number of electric lines of force passing through a given area is:

(a) No unit (b) NC^{-1}
(c) Nm^2C^{-1} (d) Nm

Tamil Nadu Board-2015

Ans. (c) :

Section-B (Very Short Answer)

146. Show the electric field lines due to a single positive charge (q > 0)

Rajasthan Board-2023

147. A dipole with its charge –q and +q located at the points (0, –b, 0) and (0, +b, 0) is present in a uniform electric field E. The equipotential surfaces of this field are planes parallel to the YZ-plane.

(i) What is the direction of the electric field E?
(ii) How much torque would the dipole experience in this field?

CBSE Delhi-2010C

148. Two charged conducting sphere of radii r_1 and r_2 connected to each other by a wire. Find the ratio of electric field at the surfaces of the two spheres.

CBSE Delhi-2011C

149. Two uniformly large parallel thin plates having charge densities + σ and – σ are kept in the XZ - plane at a distance d apart. Sketch an equipotential surface due to electric field between the plates. If a particle of mass m and charge –q remains stationary between teh plates. What is the magnitude and direction of this field?

CBSE Delhi-2011

150. Why are electric field lines perpendicular at a point on an equipotential surface of a conductor?

CBSE All India-2015C

151. Write the SI unit of electric flux.

Karnataka Board-March, 2020

152. Write two properties of electric field lines.

Gujarat Board-2020, 2022
Uttarakhand Board-2020
Tamil Nadu Board-2016, 2018
Karnataka Board-March, 2016, 2017, 2018
Karnataka Board-July, 2015, 2019, 2020

153. Sketch the electric lines of force due to a point charge q. If i) q<0 and q>0.

Karnataka Board-July, 2016

154. Write the SI unit of electric field.

Karnataka Board-July, 2016

155. What is the electric field inside a thin charged spherical shell?

Karnataka Board-July, 2020

156. Establish a relation for electric field intensity due to a uniformly charged spherical shell at a point outside the shell.

Uttarakhand Board-2020

157. Derive an expression for intensity of electric field due to a uniformly charged infinite plane sheet at a point near it. **2**

Uttarakhand Board-2019

158. What is the value of electric field intensity at any point inside a solid charged conducting sphere? **1**

Uttarakhand Board-2019

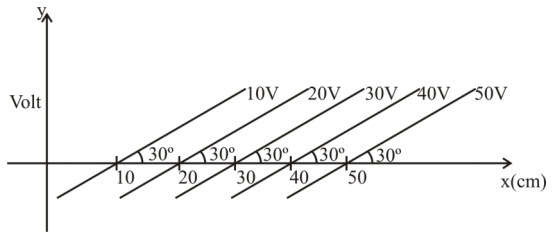
159. Define electric flux. Write its SI unit.

CBSE-2023
Chhattisgarh Board-2019
Bihar Board-2019

160. What is electrostatic shielding? How can it be achieved?

Bihar Board-2022
Assam Board-2013

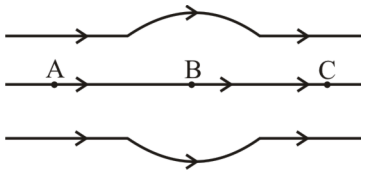
161. Some equipotential surfaces are shown in the figure. What can you say about the magnitude and direction of the electric field?



Kerala Board-2013

162. The region around a charge where its effect can be felt is called the electric field.

(a) The electric field lines corresponding to an electric field is shown below.



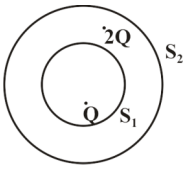
The figure suggests that

(i) $E_A>E_B>E_C$
(ii) $E_A=E_B=E_C$
(iii) $E_A<E_B<E_C$
(iv) $E_A=E_C>E_B$
(v) $E_A=E_C<E_B$

Kerala Board-2013

Search On TG: @apna_pdf

163. S_1 and S_2 are two parallel concentric spheres enclosing charges Q and 2Q respectively as shown in the figure below. What is the ratio of electric flux through S_1 and S_2?



Meghalaya Board-2018

164. Write the mathematical expression and SI unit of electric flux.

Meghalaya Board-2013

165. Show that the electric flux passing through a surface parallel to the electric field is zero.

MP Board-2022

166. A particle of mass m and charge q traverses distance d from the rest in a uniform electric field E. Prove that the velocity (v) attained by the particle is $v = \sqrt{\frac{2qEd}{m}}$.

UP Board-2023

167. A charged oil drop weighing 1.6×10^{-15} N is found to remain suspended in a uniform electric field of intersity 2×10^3 NC^{-1}. Find the charge on the drop.

ISC-2016

168. Two point charges $Q_1 = 400\mu C$ and $Q_2 = 100\ \mu C$ are kept fixed, 60cm apart in vacuum. Find intersity of the electric field at mid-point of the line joining Q_1 and Q_2.

ISC-2016

169. A point charge of 5×10^{-6} C experiences a force of 2×10^{-3} N when kept in a uniform electric field of intensity E. Then, find the value of E.

ISC-2012

170. Draw (at least three) electric lines of force due to an electric dipole.

ISC-2008

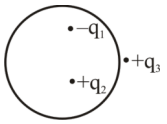
171. Draw a pattern of electric field lines due to two positive charges placed a distance d apart.

CBSE-2019

172. A proton released from rest in an electric field, will start moving towards a region of _____ potential in the field.

CBSE-2020

173. Electric flux through a spherical surface shown in the figure, is _____ .



CBSE-2020

174. Give the properties of electric line of forces.

J&K Board-2014, 2015

175. Charge density of an infinite linear charge is 2 microcoulomb/metre.
Determine the value of electric field intensity at a point which is 5 cm away perpendicularly from this linear charge in air.

Rajasthan Board-2011

176. What are electric field lines? Mention any two of its properties.

Jharkhand Board-2020

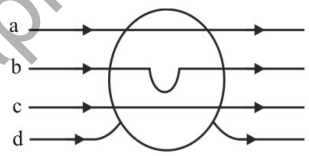
177. An infinite line charge produces on electric field of $1.8 \times 10^5 NC^{-1}$ at a distance of 2 cm. Calculate the linear charge density :

Jharkhand Board-2020

178. Point charge (+Q) is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate.

CBSE Foreign-2014

179. A metallic sphere is placed in a uniform electric field as shown in the figure.
Which path is followed by electric field lines and why?



CBSE Foreign-2010

180. A proton is placed in a uniform electric field directed along the positive X-axis. In which direction will it tend to move?

CBSE Delhi-2011 C

181. Draw a plot showing the variation of electric field (E) with distance r due to a point charge q.

CBSE Delhi-2012

182. Why must electrostatic field at the surface of a charged conductor be perpendicular to every point on it?

CBSE Foreign-2014
CBSE Delhi-2012

183. Why do the electric field lines never cross each other?

CBSE All India-2014

184. Why do the electrostatic field lines not form closed loop?

CBSE All India-2014
CBSE Delhi-2012

185. Draw the pattern of electric field lines due to an electric dipole.

CBSE All India-2019

186. Draw a pattern of electric field lines due to two positive charges placed a distance d apart.

CBSE All India-2019

Search On TG: @apna_pdf

187. Draw the pattern of electric field lines, when a point charge-Q is kept near an uncharged conducting plate.

CBSE Delhi-2019

188. If the electric flux entering and leaving a closed surface in air are ϕ_1 and ϕ_2 respectively, the net electric charge enclosed within the surface is _____.

CBSE-2020

189. A thin straight infinitely long conducting wire having charge density λ is enclosed by a cylindrical surface of radius r and length *l*, its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder.

CBSE All India-2011

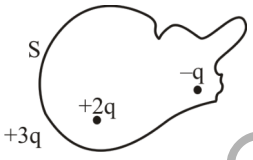
190. Show that the electric field at the surface of a charged conductor is given by $\mathbf{E} = \frac{\sigma}{\varepsilon_0}\hat{\mathbf{n}}$ where σ is the surface charge density and $\hat{\mathbf{n}}$ is a unit vector normal to the surface in the outward direction.

CBSE All India-2010

191. What is the electric flux through a cube of side 1 cm which encloses an electric dipole?

CBSE All India-2015

192. Figure shows three point charges, +2q, –q and +3q. Two charges + 2q and –q are enclosed within a surface S. What is the electric flux due to this configuration through the surface S?



CBSE Delhi-2010

Section-C (Short Answer)

193. Explain why two lines of force in an electric field cannot intersect each other

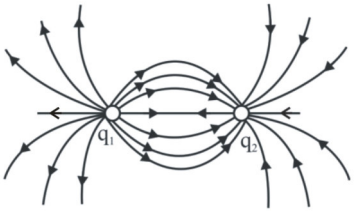
Odisha Board-2023

194. If $\vec{\mathbf{E}} = \left(3\hat{\mathbf{i}} + 6\hat{\mathbf{j}} + 4\hat{\mathbf{k}}\right)\frac{\mathbf{N}}{\mathbf{C}}$, calculate the electric flux through a surface of area $20cm^2$ in Y-Z plane.

Assam Board-2014

195. **(a)** Write any two properties of electric field lines.

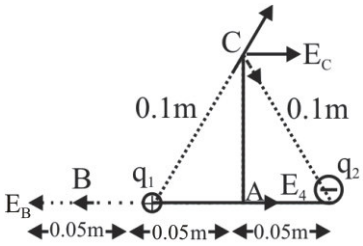
(b) Observe the figure and write the signs of the charges q_1 and q_2.



Kerala Board-2021

196. Electric field is an important way of characterizing the electrical environment of a system of charges.

Two points charges q_1 and q_2 of $+ 10^{-8}C$ and $- 10^{-8}C$ respectively are placed 0.1 m apart. Calculate the electric fields at points A, B and C shown in the figure.



Kerala Board-2014

197. What is meant by electric flux? Write its S.I. unit and dimensional formula.

MP Board-2013

198. Define electric field due to a point charge. Write the mathematic expression for it in the vector form. What is the SI unit of electric field? Draw the electric field lines due to (a) an isolated positive charge, (b) an isolated negative charge and (c) an electric dipole.

NIOS-2012

199. Define electric lines of force (field lines). State their six properties.

NIOS-2014

200. A uniformly charged straight wire of infinite length has linear charge density of 10×10^{-8} coulomb/metre. Calculate the electric field intensity at a perpendicular distance of 2 cm from the wire

UP Board-2020

201. **(a)** Draw equipotential surface corresponding to the electric field that uniformly increases in magnitude along with the z-directions.

(b) Two charges – q and + q are located at points (0, 0, – a) and (0, 0, a). What is the electrostatic potential at the point (0, 0 ± z) and (x, y, 0)?

CBSE-2019

202. Twelve negative charges of same magnitude are equally spaced and fixed on the circumference of a circle of radius R as shown in Fig. (i). Relative to potential being zero at infinity, find the electric potential and electric field at the centre C of the circle.

CBSE-2023

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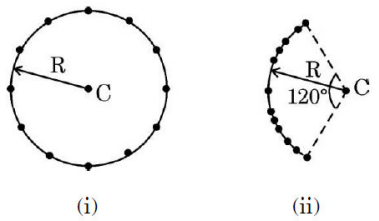
203. If the charges are unequally spaced and fixed on an arc of 120 of radius R as shown in Fig. (ii), find electric potential at the centre C.



CBSE-2023

204. **(b)** A particle of charge 2 μC and mass 1.6 g is moving with a velocity $4\hat{\mathbf{i}}\ ms^{-1}$. At t = 0 the particle enters in a region having an electric field $\vec{\mathbf{E}}$ (in NC^{-1}) = $80\hat{\mathbf{i}} + 60\hat{\mathbf{i}}$. Find the velocity of the particle at t = 5s.

CBSE-2020

205. **(a)** Two electric field lines cannot cross each other. Also, they cannot from closed loops. Give reasons.

CBSE-2020

206. Derive an expression for electric field intensity E near a thin uniformly charged infinite plane sheet.

Haryana Board-2018

207. What is electric flux ? State Gauss's law for electric flux. Write important points regarding this law.

Haryana Board-2018

208. In a certain region the electric potential is given by the formula $V(x,y,z) = 2x^2y + 3y^3z - 4z^4x$. Find the components of electric field and the vector electric field at point (1, 1, 1) in this field.

Gujarat Board- May, 2021

209. An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude **2×10^4 NC^{-1}. The direction of the field is reversed keeping its magnitude unchanged and a proton falls through the same distance. Compute the time of fall in each case.**

Gujarat Board- March, 2020

210. Derive an expression for the electric field due to an infinitely long straight uniformly charged wire.

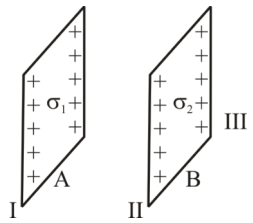
Gujarat Board-March, 2022

Section-D (Case-Based Questions)

211. Derive an expression for the magnitude of electric field intensity at a point on the equatorial line of an electric dipole. Also write the expression in vector form. Show that at a given distance from the centre of a short electric dipole, the magnitude of electric field intensity on the axial line is twice that of the equatorial line.

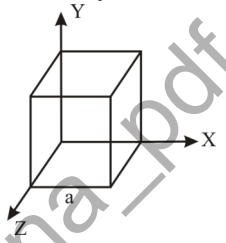
Meghalaya Board-2015

212. Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and is σ_2 ($\sigma_1 - \sigma_2$) are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked II and III.



CBSE Foreign-2014

213. Given the electric field in the region $E = 2x\hat{\mathbf{i}}$, find the net electric flux through the cube and the charge enclosed by it.



CBSE All India-2015
CBSE Delhi-2015

Section-E (Long Answer)

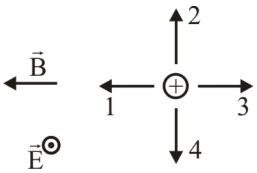
214. What is meant by Electric Flux? State the Gauss's law in electrostatics and using this, find the expression for electric field intensity due to a uniformly charged infinite plane sheet.

Uttarakhand Board-2022

215. Explain the concept of electric field. Express electric flux through a surface in terms of electric field intensity. Show that the electric flux through a cylindrical surface with its axis parallel to a uniform electric field is zero.

Assam Board-2015

216. The figure shows four directions for the velocity vector $\vec{v}$ of a positively charged particle. It is moving through a uniform electric field $\vec{\mathbf{E}}$ directed normally out of the page and a uniform magnetic field $\vec{B}$ as shown:



(a) Which direction of motion will give the particle the greatest net force ?

(b) Motion in which direction may result in net force zero on the particle.

(c) Write the equation of the the speed of the charged particle when it moves undeflected in the field.

Goa Board-2023

Search On TG: @apna_pdf

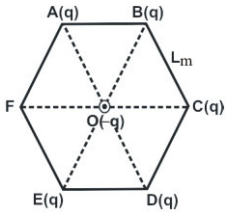
217. What are electric field lines? State their three properties. Draw electric field lines for

(a) single positive point charge; and (b) electric dipole**.**

NIOS-2021

218. **(a)** Define electric field at a point. State its SI unit. Explain why test charge q_0 should be infinitesimally small. Show the direction of the electric field due to isolated **(i)** +ve and **(ii)** –ve charge.

(b) Five point charges each of magnitude q C are placed on five vertices of a regular hexagon of side L metre. Find the magnitude of force on a charge –q C, placed at the centre of the hexagon.



NIOS-2013

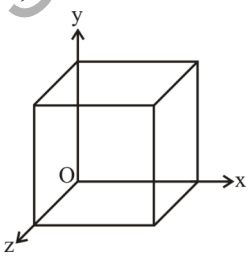
219. Derive an expression for the electric field at a point on the equatorial plane of an electric dipole consisting of charges q and –q separated by a distance 2a.

CBSE-2023

220. A thin circular ring of radius r is charged uniformly so that its linear charge density becomes λ. Derive an expression for the electric field at a point P at a distance x from it along the axis of the ring. Hence, Prove that at large distance (x >> r), the ring behaves as a point charge.

CBSE-2020

221. A cube of side 20 cm is kept in a region as shown in the figure. An electric field $\vec{E}$ exists in the region such that the potential at a point is given by V = 10x + 5, where V is in volt and x is in m.



Find the

(i) electric field $\vec{E}$, and

(ii) total electric flux through the cube.

CBSE-2020

222. Two identical metallic spheres A and B having charges + 4Q and –10Q are kept a certain distance apart. A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B. then, spheres A and B are brought in contact and then separated. Find the charges on the spheres A and B.

CBSE All India-2011 C

223. **(i)** Define electric flux. Write its SI unit.

(ii) Using Gauss' law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of distance from it. How is the field directed if

(a) the sheet is positively charged?

(b) negatively charged?

CBSE Delhi-2012

224. Define electric flux. Write its SI unit.

CBSE Delhi-2012C

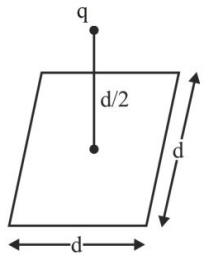
225. Define electric flux. Write its SI unit, Gauss' law in electrostatics is true for any closed surface, no matter what its shape or size is. Justify this statement with the help of a suitable example.

CBSE Delhi-2015

226. An infinitely large thin plane sheet has a uniform surface charge density +σ. Obtain the expression for the amount of work done in bringing a point charge q from infinity to a point, distant r, in front of the charged plane sheet.

CBSE All India-2017

227. Define electric flux. Is it a scalar or a vector quantity? A point charge q is at a distance of d/2 directly above the centre of a square of side d, as shown in the figure.



Use Gauss' law to obtain the expression for the electric flux through the square.

CBSE-2018

228. If the point charge is now moved to a distance d from the centre of the square and the side of the square is doubled, explain how the electric flux will be affected.

CBSE-2018

229. Why two electric lines of force / field cannot intersect each other?

Punjab Board-2018

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IV. Electric Dipole and Dipole in a Uniform External Field

Section-A (Multiple Choice Questions)

230. Which of the following relations is correct for torque $(\vec{\tau})$ acting on an electric dipole of dipole moment $\vec{P}$ placed in electric field intensity $\vec{E}$?

(a) $\vec{\tau} = \vec{P} \times \vec{E}$ (b) $\vec{\tau} = \vec{P}.\vec{E}$

(c) $\tau = PE$ (d) $\tau = P/E$

Bihar Board-2021

Ans. (a) :

231. The electric potential in equatorial position of an electric dipole is

(a) $\frac{1}{4\pi\epsilon_0}\frac{p\cos\theta}{r^2}$ (b) $\frac{1}{4\pi\epsilon_0}\frac{p}{r^2}$

(c) $\frac{1}{4\pi\epsilon_0}\frac{p}{r}$ (d) zero

Bihar Board-2022

Ans. (a) :

232. What is the angle between the electric dipole moment $\vec{P}$ and the electric field strength $\vec{E}$ when the dipole is in a stable equilibrium?

(a) $\frac{\pi}{4}$ (b) π

(c) $\frac{\pi}{2}$ (d) 0

Bihar Board-2023

Ans. (d) :

233. An electric dipole of moment p is lying along a uniform electric field E. The work done in rotating the dipole by 90° is

(a) pE (b) $\sqrt{2}$pE

(c) $p\frac{E}{2}$ (d) 2pE

Meghalaya Board-2015

Ans. (d) :

234. A dipole of electric dipole moment p is placed in a uniform electric field of strength E. If θ is the angle between positive direction of p and E, then the potential energy of the electric dipole is minimum when θ is

(a) 90° (b) 0°

(c) 45° (d) 180°

Meghalaya Board-2013

Ans. (b) :

235. The angle at which maximum torque is exerted by the external uniform electric field on the electric dipole is _____.

(a) 0º (b) 30º

(c) 45º (d) 90º

Maharashtra Board-2022

Ans. (d) :

236. The angle between electric field and dipole moment of an axial position of the electric dipole.

(a) 0^0 (b) 180^0

(c) 90^0 (d) 270^0

MP Board-2020

Ans. (b) :

237. An electric dipole of length 2 cm is placed at an angle of 30° with an electric field 2×10^5 N/C. If the dipole experiences a torque of 8×10^{-3} Nm, the magnitude of either charge of the dipole, is

(a) 4 μC (b) 7μC

(c) 8 mC (d) 2 mC

CBSE-2023

Ans. (a) :

238. An electric dipole of dipole moment 2×10^{-8} C-m in a uniform electric field experiences a maximum torque of 6×10^{-4} N-m. The magnitude of electric field is

(a) 2.2×10^3 Vm^{-1} (b) 1.2×10^4 Vm^{-1}

(c) 3.0×10^4 Vm^{-1} (d) 4.2×10^3 Vm^{-1}

CBSE-2023

Ans. (c) :

239. A point charge situated at a distance 'r' from a short electric dipole on its axis, experiences a force $\vec{F}$. If the distance of the charge is '2r', the force on the charge will be:

(a) $\frac{\vec{F}}{16}$ (b) $\frac{\vec{F}}{8}$

(c) $\frac{\vec{F}}{4}$ (d) $\frac{\vec{F}}{2}$

CBSE-2023

Ans. (b) :

240. A point charge is situated at an axial point of a small electric dipole at a large distance from it. The charge experiences a force F. If the distance of the charge is doubled, the force acting on the charge will become .

(a) 2F (b) F/2

(c) F/4 (d) F/8

CBSE-2020

Ans. (d) :

241. An electric dipole is placed in a uniform field. The resultant force acting on it——.

(a) never be zero

(b) depends on its relative moment

(c) always be zero

(d) depends on its dipole moment

Gujarat Board- May, 2021

Ans. (c) :

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242. Electric field due to dipole at large distance (r) falls off as ——.

(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$

(c) $\frac{1}{r^3}$ (d) $\frac{1}{r^4}$

Gujarat Board- March, 2020

Ans. (c) :

243. An electric dipole with dipole moment 4×10^{-9} cm is aligned at 30° with the direction of a uniform electric field of magnitude 5×10^4 NC^{-1}. The magnitude of the torque on the dipole is _____J.

(a) 10^2 (b) 10^{-2}

(c) 10^4 (d) 10^{-4}

Gujarat Board- July, 2022

Ans. (d) :

244. The electric field and the potential of an electric dipole vary with distance r as

(a) $\frac{1}{r}$ and $\frac{1}{r^2}$ (b) $\frac{1}{r^2}$ and $\frac{1}{r}$

(c) $\frac{1}{r^2}$ and $\frac{1}{r^3}$ (d) $\frac{1}{r^3}$ and $\frac{1}{r^2}$

Jharkhand Board-2023

Ans. (d) :

245. A dipole is placed in a uniform electric field with its axis parallel to the field. It experiences :

(a) Both a net force and torque

(b) Only a net force

(c) Neither a net force nor a torque

(d) Only a torque

Tamil Nadu Board-2016, 2018

Ans. (c) :

246. A given charge situated at a certain distance from an electric dipole of very small length along its axial line experiences a force F. If the distance of the charge is doubled, the force on the charge will become.

(a) 2F (b) F/2

(c) F/4 (d) F/8

Meghalaya Board-2018

Ans. (d) :

Section-B (Very Short Answer)

247. Write the value of electric field due to an electric dipole at a point on its axis.

Rajasthan Board-2023

248. Torque acting on an electric dipole placed in an electric field is maximum when the angle between the electric field and the dipole moment is _____.

CBSE-2020

249. Draw equipotential surfaces for an electric dipole.

CBSE Delhi-2019

250. An electric dipole of dipole moment 4×10^{-9} C-m is inclined at an angle 30° to a uniform electric field of magnitude 5×10^4 N/C. Calculate the torque appiled on electric dipole.

Uttarakhand Board-2020

251. Write the formula for the intensity of electric field at a point in the axial position of a electric dipole, giving the meaning of the symbols used.

Uttarakhand Board-2022

252. Derive an expression for the intensity of the electric field at a point on the equatorial plane of an electric dipole.

AP Board-2021

253. Derive an expression for the intensity of the electric field at a point on the axial line of an electric dipole.

AP Board-2022

Tamil Nadu Board-2016, 2018

254. Write the definition and S.I. unit of electric dipole moment.

Bihar Board-2021

255. What is an electric dipole? Find an expression for the torque acting on an electric dipole placed in an external uniform electric field.

Assam Board-2013

256. **(a) (i)** What is an electric dipole ? An electric dipole with dipole moment 4×10^{-9} cm is aligned at 30° with the direction of a uniform electric field of magnitude 5×10^4 NC^{-1}. Calculate the magnitude of the torque.

Assam Board-2023

257. Prove that the electric potential at a point in broad side on position due to an electric dipole is zero.

MP Board-2015

258. Write SI unit and dimensional formula of electric dipole moment.

Chhattisgarh Board-2022

259. Whether electric dipole moment is a vector or a scalar quantity?

Write the SI unit of electric dipole moment

Chhattisgarh Board-2021

260. How will an electric dipole behave when placed in a non-uniform electric field ?

NIOS-2022

261. Maximum torque acting on an electric dipole of moment 3×10^{-29} Cm in a uniform electric field E is 6×10^{-25} Nm. Find the value of E.

ISC-2017

262. What will be the net electric force acting on an electric dipole placed in a uniform electric field?

ISC-2007

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263. Draw the pattern of electric field lines due to an electric dipole.

CBSE-2019

264. An electric dipole of dipole moment $(\vec{p})$ is kept in a uniform electric field $\vec{E}$. Show graphically the variation of torque acting on the dipole (τ) with its orientation (θ) in the field. Find the orientation in which torque is (i) zero and (ii) maximum.

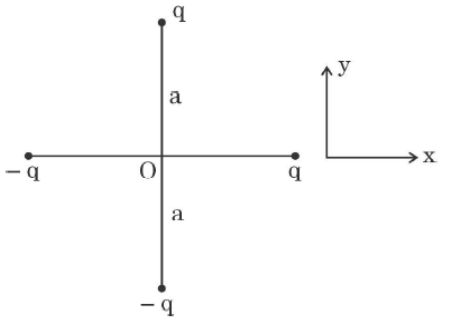
CBSE-2023

265. Depict the orientation of an electric dipole in (a) stable and (b) unstable equilibrium in an external uniform electric field.

Write the potential energy of the dipole in each case.

CBSE-2023

266. Two identical dipoles are arranged in x-y plane as shown in the figure. Find the magnitude and the direction of net electric field at the origin O

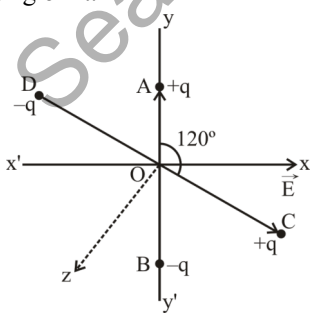


CBSE-2023

267. Two small identical electric dipoles AB and CD, each of dipole moment $\vec{p}$ are kept at an angle of 120º to each other in an external electric field $\vec{E}$ pointing along the x-axis as shown in the figure. Find the

(a) dipole moment of the arrangement, and

(b) magnitude and direction of the net torque acting on it.



CBSE-2020

268. Establish an expression for the electric field at a point along the axial line of an electric dipole.

Meghalaya Board-2021

Nagaland Board-2018, 2021

273. Derive the formula for the electric potential energy of an electric dipole in a uniform electric field.

Gujarat Board- May, 2021

269. Derive an expression for the electric potential at a point in axial position duet to an electric dipole.

Jharkhand Board-2020

270. A dipole with a dipole moment of magnitude p is in stable equilibrium in an electrostatic field of magnitude E. Find the work done in rotating this dipole to its position of unstable equilibrium.

CBSE All India-2010C

271. A dipole is present in an electrostatic field of magnitude $10^6 NC^{-1}$. If the work done in rotating it from its position of stable equilibrium to its position of unstable equilibrium is 2×10^{-23}J, then find the magnitude of the dipole moment of this dipole.

CBSE All India-2010C

272. Calculate the amount of work done in turning an electric dipole of dipole moment 3×10^{-8} C. m from its position of unstable equilibrium in a uniform electric field of intensity 10^3 NC^{-1}

CBSE Foreign-2011

273. An electric dipole of length 4cm when placed with its axis making an angle of 60º with a uniform electric field, experiences a torque of $4\sqrt{3}$ N-m. Calculate the potential energy of the dipole if it has charge ± 8nC

CBSE Delhi-2014

274. An electric dipole of length 2 cm when placed with its axis making an angle of 60º with a uniform electric field, experiences a torques $8\sqrt{3}$ N-m. Calculate the potential energy of the dipole if it has charge of ± 4nC.

CBSE Delhi-2014

275. An electric dipole of length 1cm when placed with its axis making an angle of 60º with uniform electric field, experiences a torque of $6\sqrt{3}$ N-m. Calculate the potential energy of the dipole, if it has charge ± 2nC.

CBSE Delhi-2014

276. An electric dipole is placed in a uniform electric field E with its dipole moment p parallel to the field. Find

(i) the work done in turning the dipole till its dipole moment points in the direction opposite to E.

(ii) the orientation of the dipole for which the torque acting on it becomes maximum.

CBSE All India-2014C

277. Derive an expression for the electric field due to a dipole of dipole moment p at a point on its perpendicular bisector.

CBSE Delhi-2019

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278. In which orientation, a dipole placed in a uniform electric field is in **(i)** stable equilibrium **(ii)** unstable equilibrium?

CBSE Delhi-2011

279. Define dipole moment of an electric dipole. Is it a scalar quantity or a vector quantity?

CBSE Foreign-2012
CBSE All India-2011

280. Derive an expression for the torque acting on the electric dipole when placed in a uniform electric field.

Nagaland Board-2017, 2020
Tamil Nadu Board-2016

281. What is an electric dipole? Define electric dipole moment.

J&K Board-2023
Tamil Nadu Board-2011, 2017

Section-C (Short Answer)

282. Derive the expression for electric field intensity at a point on equatorial plane due to electric dipole.

Uttarakhand Board-2019

283. An electric dipole consists of two opposite charges each of magnitude 1μC, separated by 2 cm. The dipole is placed in an external electric field of 10^5 N/C.

Calculate the:

(i) Maximum torque experienced by the dipole and

(ii) Work done by the external field to turn the dipole through 180º.

Maharashtra Board-2023

284. Prove that potential at point on transverse (equatorial) position of electric dipole is zero.

MP Board-2014

285. What is meant by an electric dipole? Derive an expression for electric field intensity due to an electric dipole in axial position at a point.

MP Board-2018

286. What is meant by the electric dipole? Obtain expression for the intensity of electric field at a point in end and off position due to an electric dipole.

MP Board-2020

287. Find the magnitude and direction of the electric field intensity due to an electric dipole of moment 10^{-10} C-m at a point 20cm from each charge. Dipole length is 10cm.

NIOS-2019

288. Derive the formula for the work done to rotate the electric dipole in electric field.

UP Board-2019

289. An electric dipole of dipole moment p is placed in a uniform electric field E with its axis inclined to the field. Write an expression for the torque τ experienced by the dipole in vector form. Show diagrammatically, show the dipole should be kept in the electric field so that the torque acting on it is

(i) Maximum **(ii)** Zero

ISC-2014

290. **(i)** Write an expression (derivation not required) for intensity of electric field in

(a) axial position.

(b) broadside position of an electric dipole, in terms of its length (2a) dipole moment (p) and distance *l*.

(ii) What is the ratio of these two intensities i.e. $E_1 : E_2$, for a short electric dipole ?

ISC-2013

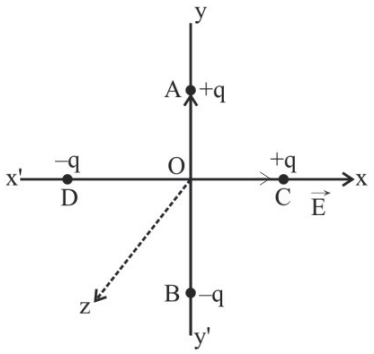
291. An electric dipole is placed in a uniform external electric field E. Show that the torque acting on the dipole is given by $\tau = p \times E$, where p is the dipole moment.

ISC-2005

292. Two small identical electric dipoles AB and CD, each of the dipole moment $\vec{p}$ are kept at an angle of 90º to each other in an external electric field $\vec{E}$ pointing along the x-axis as shown in the figure. Find the

(a) dipole moment of the arrangement, and

(b) magnitude and direction of the net torque acting on it.



CBSE-2020

293. Define electric dipole moment. Derive an expression for the electric field at a point on equatorial (broad-side-on) position of an electric dipole.

Jharkhand Board-2018, 2023

294. **(i)** Derive the expression for electric field at a point on the equatorial line of an electric dipole.

(ii) Depict the orientation of the dipole in **(a)** stable, **(b)** unstable equilibrium in a uniform electric field.

CBSE Delhi-2017
CBSE All India-2014

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295. **(i)** Obtained the expression for the torque τ experienced by an electric dipole of dipole moment p in uniform electric field, E.

(ii) What will happen, if the field were not uniform ?

CBSE Delhi-2017

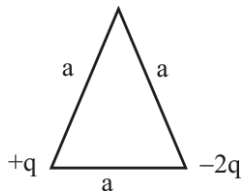
296. A charge is distributed uniformly over a ring radius a. Obtain an expression for the electric field intensity E at a point on the axis of the ring. Hence, show that for points at large distances from the ring, it behaves like a point charge.

CBSE Delhi-2016

297. An electric dipole of dipole moment p is placed in a uniform electric field E. Obtained the expression for the torque τ experienced by the dipole. Identify two pairs of perpendicular vector in the expression.

CBSE Delhi-2015C

298. Two point charges +q and –2q are placed at the vertices B and C of the an equilateral ΔABC of side a as given in the figure. Obtain the expression for



(i) the magnitude and

(ii) the direction of the resultant electric field at the vertex A due to these two charges.

CBSE All India-2014C

299. Define the term electric dipole moment. Is it a scalar or vector? Deduce an expression for the electric field at a point on the equatorial plane of an electric dipole of length 2a.

CBSE All India-2013

300. An electric dipole is kept in a uniform electric field. Derive an expression for the net torque acting on it and write its direction. State the conditions under which the dipole is in

(i) stable equilibrium

(ii) unstable equilibrium.

CBSE Delhi-2012C

301. Sketch the pattern of electric field lines due to

(i) a conducting sphere having negative charge it.

(ii) an electric dipole.

CBSE All India-2011C

302. What is an electric dipole? Derive an expression for the electric field due to an electric dipole at a point on the4 equatorial line.

Tamil Nadu Board-2015

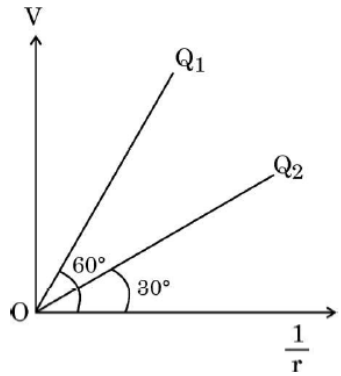
Section-D (Case-Based Questions)

303. Electrostatics deals with the study of forces, fields and potentials arising from static charges. Force and electric field, due to a point charge is basically determined by Coulomb's law. For symmetric charge configurations, Gauss's law, which is also based on Coulomb's law, helps us to find the electric field. A charge/a system of charges like a dipole experience a force/torque in an electric field. Work is required to be done to provide a specific orientation to a dipole with respect to an electric field.

Answer the following questions based on the above :

(a) Consider a uniformly charged thin conducting shell of radius R. Plot a graph showing the variation of $|\vec{E}|$ with distance r from the centre, for points $0 \le r \le 3R$.

(b) The figure shows the variation of potential V with $\frac{1}{r}$ for two point charges Q_1 and Q_2, where V is the potential at a distance r due to a point charge. Find $\frac{Q_1}{Q_2}$.



(c) An electric dipole of dipole moment of 6×10^{-7} C-m is kept in a uniform electric field of 10^4 N/C such that the dipole moment and the electric field are parallel. Calculate the potential energy of the dipole.

OR

(c) An electric dipole of dipole moment $\vec{p}$ is initially kept in a uniform electric field $\vec{E}$ such that $\vec{p}$ is perpendicular to $\vec{E}$. Find the amount of work done in rotating the dipole to a position at which $\vec{p}$ becomes anti-parallel to $\vec{E}$.

CBSE-2023

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Section-E (Long Answer)

304. Show that the magnitude of the electric field at an axial point far away from a short electric dipole is inversely proportional to the cube of its distance from the centre of the dipole

Meghalaya Board-2013

305. Define electric dipole and dipole moment. Derive an expression for electric field intensity at a point on the axial line of an electric dipole.

Assam Board-2015

306. Derive an expression for the electric potential at any point at a distance r from the centre of an electric dipole. Hence find the potential if the point lies on **(i)** axial line and **(ii)** equatorial line.

Meghalaya Board-2019

307. **(b)** Why two electric lines of force cannot intersect each other ?

Meghalaya Board-2021

308. Obtain an expression for the electric field due to an electric dipole at a point on the line passing through the centre of the dipole and perpendicular to the dipole axis. Express the result in vector form.

Meghalaya Board-2017, 2023

309. What is an electric dipole? Establish an expression for finding electric field intensity of an electric dipole for equatorial position.

MP Board-2022

310. Derive an expression for potential due to an electric dipole at any point (r, θ). How is this expression modified when the point lies on the equatorial line of the dipole?

NIOS-2012

311. Derive an expression for potential due to an electric dipole at a point (r, θ), What will be the expression for the potential for special cases, when the point lies–

(a) on the axial line but on the side of positive charge.

(b) on the axial line but on the side of negative charge.

(c) on the equatorial line of dipole?

NIOS-2014

312. In the following, if the distance of observation point from the centre of source becomes half, then how much electric field be changed and why ?

(i) a point charge

(ii) an electric dipole

(iii) an infinite charged sheet

UP Board-2018

313. Obtain the expression for moment of couple acting on electric dipole placed in a uniform electric field. Define electric dipole moment on its basis.

UP Board-2022

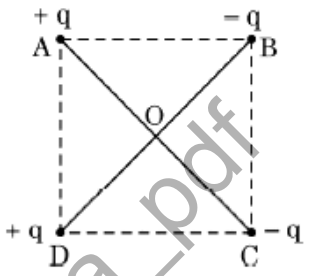
314. Derive an expression for intensity of electric field at a point in broadside position or on an equatorial line of an electric dipole**.**

ISC-2015

315. Obtain an expression for intensity of electric field in end on position, i.e. axial position of an electric dipole**.**

ISC-2011

316. Two identical electric dipoles are placed along the diagonals of a square ABCD of side $\sqrt{2}$ m as shown in the figure. Obtain the magnitude and direction of the net electric field at the centre (O) of the square.



CBSE-2023

317. The distance of a far off point on the equatorial plane of an electric dipole is halved. How will the electric field be affected for the dipole?

CBSE-2023

318. **(a)** An electric dipole of dipole moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$ at an angle θ with it. Derive the expression for torque $(\vec{r})$ acting on it. Find the orientation of the dipole relative to the electric field for which torque on it is (i) maximum, and (ii) half of maximum.

(b) Two point charges $q_1 = +1\ \mu C$ and $q_2 = +4\ \mu C$ are placed 2 m apart in air. At what distance from q_1 along the line joining the two charges, will the net electric field be zero?

CBSE-2020

319. Deduce the expression for the torque acting on a dipole of dipole moment p in the presence of uniform electric field E.

CBSE All India-2014

320. An electric dipole of dipole moment p consists of point charges +q and –q separated by a distance 2a apart.

Deduce the expression for the electric field E due to the dipole at a distance x from the centre of the dipole on its axial line in terms of the dipole moment p. Hence, show that in the limit x>>a, $E \rightarrow 2p/(4\pi\varepsilon_o x^3)$.

CBSE All India-2015

CBSE Delhi-2015

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321. **(i)** Derive an expression for the electric field E due to a dipole of length $2l$ at a point distant r from the centre of the dipole on the axial line.

(ii) Draw a graph of E versus r for $r >> l$.

(iii) If this dipole is kept in a uniform external electric field E_0, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in both the cases.

CBSE All India-2017

322. **(a)** Define torque acting on a dipole of dipole moment p placed in a uniform electric field E. Express it in the vector form and point out the direction along which it acts.

(b) What happens if the field is non-uniform?

(c) What would happen if the external field E is increasing (a) parallel to p and (b) anti-parallel to p?

CBSE Foreign-2016

323. **(i)** Derive an expression for the electric field at any point on the equatorial line of an electric dipole.

(ii) Two identical point charges, q each are kept 2 m apart in air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charge such that the system remains in equilibrium. Find the position and nature of Q.

CBSE Delhi-2019

324. Derive an expression for electrostatic potential due to an electric dipole.

Tamil Nadu Board-2022

V. Gauss's Law and Application of Gauss's Law

Section-A (Multiple Choice Questions)

325. **A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of 80 μC m^{-2}. The charge on the sphere is _____ mC.**

(a) 1.45 (b) 5.41
(c) 4.51 (d) 45.1

Gujarat Board-March, 2022

Ans. (a) :

326. **Electric intensity outside a charged cylinder having the charge per unit length 'λ' at a distance r from its axis is____.**

(a) $E = \frac{2\pi \in_0 \lambda}{kr^2}$ (b) $E = \frac{\in_0 \lambda}{2\pi Kr^2}$

(c) $E = \frac{\lambda}{2\pi \in_0 Kr}$ (d) $E = \frac{4\pi \in_0 \lambda}{kr^2}$

Maharashtra Board-2018

Ans. (c) :

327. **The electric field intensity outside the charged conducting sphere of radius 'R', placed in a medium of permittivity ∈ at a distance 'r' from the centre of the sphere in terms of surface charge density σ is**

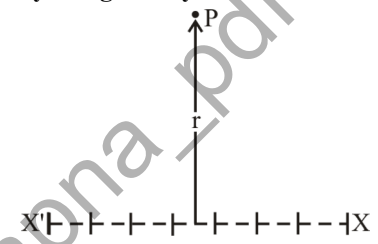
(a) $\frac{\sigma}{\in}\left(\frac{R}{r}\right)^2$ (b) $\frac{\sigma}{\in}\left(\frac{r}{R}\right)^2$

(c) $\frac{\sigma}{\in}\left(\frac{R^2}{r^2}\right)^2$ (d) $\frac{\in}{\sigma}\left(\frac{r}{R}\right)^2$

Maharashtra Board-2019

Ans. (a) :

328. **Electric field intensity E at a point P at a perpendicular distance r from an infinitely long line charge X' X having linear charge density λ is given by**



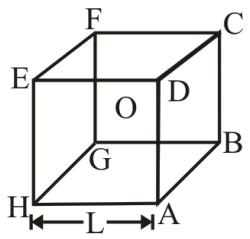
(a) $E = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{2\lambda}{r^2}$ (b) $E = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{2\lambda}{r}$

(c) $E = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{\lambda}{r^2}$ (d) $E = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{\lambda}{r}$

ISC-2014, 2010

Ans. (b) :

329. **A short electric dipole which consists of two point charges –q and + q, is placed at the centre O and inside a large cube (ABCDEFGH) of length L as shown in the figure. The electric flux emanating through the cube is**



(a) $q/4\pi\varepsilon_0 L$ (b) zero
(c) $q/2\pi\varepsilon_0 L$ (d) $q/3\pi\varepsilon_0 L$

ISC-2015

Ans. (b) :

330. **Two charges q_1 and q_2 are placed at the centres of two spherical conducting shells of radius r_1 and r_2 respectively. The shells are arranged such that their centres are d [> (r_1 + r_2)] distance apart. The force on q_2 due to q_1 is**

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(a) $\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{d^2}$ (b) $\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{(d-r_1)^2}$

(c) Zero (d) $\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{[d-(r_1+r_2)]^2}$

CBSE-2023

Ans. (a) :

331. A charge Q is uniformly distributed over the surface of a spherical shell of radius R. The work done in bringing a test charge Q_0 from its centre to its surface is

(a) $\frac{1}{4\pi\varepsilon_0}\frac{QQ_0}{R}$ (b) $\frac{1}{4\pi\varepsilon_0}\frac{QQ_0}{2R}$

(c) $\frac{QQ_0}{\varepsilon_0 R}$ (d) zero

CBSE-2020

Ans. (d) :

332. Two large conducting spheres carrying Q_1 and Q_2 are kept with their centres r distance apart. The magnitude of electrostatic force between them is not exactly $\frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{r^2}$ because

(a) these are not point charges.
(b) charge distribution on the spheres is not uniform
(c) charges on spheres will shift towards the centres of their respective spheres.
(d) charges will shift towards the portions of the spheres which are closer and facing towards each other.

CBSE-2020

Ans. (b) :

333. Dimension of $\frac{1}{\sqrt{\mu_0 \in_0}}$ is

(a) LT^{-1} (b) LT^{-2}
(c) $L^{-1}T^{-2}$ (d) L^2T^{-1}

J&K Board-2014, 2015

Ans. (b) :

334. The dependence of electric potential (V) on distance (r) inside a uniformly charged spherical shell is-

(a) $V \propto r$ (b) V= constant

(c) $V \propto \frac{1}{r}$ (d) $V \propto \frac{1}{r^2}$

Rajasthan Board-2022

Ans. (c) :

335. A conducting sphere of radius 10 cm has an unknown charge. If the electric field 20cm form the centre of the sphere is 1.5×10^3 N/C and points radically inwards, what is the net charge on the sphere?

(a) $-66.8\mu c$ (b) $+6.68 nc$
(c) $-6.68 nc$ (d) $+66.8\mu c$

Gujarat Board- August, 2020

Ans. (b) :

336. According to Gauss' law of electrostatics

(a) $\phi_E = \frac{\varepsilon_o}{2}$ (b) $\phi_E = \frac{q}{\varepsilon_o}$

(c) $\phi_E = q\varepsilon_o$ (d) $\phi_E = \frac{1}{q\varepsilon_o}$

Jharkhand Board-2023

Ans. (b) :

337. A and B are two hollow metal spheres of radii 50cm and 1 m carrying charges 0.6 μC and 1 μC respectively. They are connected externally by a conducting wire. Now the charge flows from:

(a) A to B till the charges become equal
(b) A to B till the potentials become equal
(c) B to A till the charges become equal
(d) B to A till the potentials become equal

Tamil Nadu Board-March, 2016

Ans. (b) :

338. A hollow metal ball carrying an electric charge produces no electric field at points:

(a) outside the sphere
(b) on its surface
(c) inside the sphere
(d) at a distance more than twice

Tamil Nadu Board-2016, 2017

Ans. (c) :

339. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^2 C and 5×10^{-2}C respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is :

(a) 1×10^{-2}C (b) 3×10^{-2}C
(c) 2×10^{-2}C (d) 4×10^{-2}C

Tamil Nadu Board-2022

Ans. (b) :

340. The electric field at a point 2 cm from an infinite line charge of linear charge density 10^{-7} cm^{-1} is :

(a) 4.5×10^4 NC^{-1} (b) 9×10^4 NC^{-1}
(c) 9×10^2 NC^{-1} (d) 18×10^4 NC^{-1}

Tamil Nadu Board-2017

Ans. (b) :

341. The electric field outside the plates of two oppositely charged plane sheets of charge density o is

(a) $\frac{+\sigma}{2\varepsilon_0}$ (b) $\frac{-\sigma}{2\varepsilon_0}$

(c) $\frac{\sigma}{\varepsilon_0}$ (d) zero

Tamil Nadu Board-2011

Ans. (d) :

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342. If + q charge is placed inside any spherical surface then total flux coming out from whole surface will be -

(a) $q \times \varepsilon_0$ (b) $\frac{q}{\varepsilon_0}$

(c) $\frac{\varepsilon_0}{q}$ (d) $\frac{q^2}{\varepsilon_0}$

Bihar Board-2019

Ans. (b) :

Section-B (Very Short Answer)

343. A uniformly charged thin spherical shell has an electric field at all points_____ inside it.

Rajasthan Board-2023

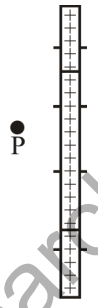
344. State Gauss's law in electrostatics. Explain its importance.

UP Board-2022
Telangana Board-2015, 2018
ISC-2007, 2016
Assam Board-2013

345. The volume charge density within a volume V is $\rho(r)$. What is the force on a small test charge q_0 placed outside the volume having position vector $\vec{r}_0$ with respect to the same origin considered to specify the position vector of the charge distribution within the volume.

Assam Board-2017

346. An infinitely long thin straight wire with uniform linear charge density is shown in figure.



(a) Draw a Gaussian surface in order to calculate the electric field at P and mark direction of electric field at this point.

(b) Derive an expression to calculate electric field at this point P.

Kerala Board-2020

347. Intensity of electric field at a perpendicular distance of 0.5m from an infinitely long line charge having linear charge density (λ) is 3.6×10^3 Vm^{-1}. Find the value of λ

ISC-2017

348. An infinite line charge produces a field of 9×10^4 NC^{-1} at a distance of 2 cm. Calculate the linear charge density.

ISC-2006

349. A large hollow metallic sphere has a positive charge of 35.4 μC at its centre. Find how much electric flux emanates from the sphere ?

ISC-2013

350. Apply Gauss's law to show that for a charged spherical shell, the electric field outside the shell is, as if the entire charge were concentrated at the centre.

CBSE-2019

351. Two large parallel plane sheets have uniform charge densities + σ and – σ. Determine the electric field (i) between the sheets, and (ii) outside the sheets.

CBSE-2019

352. A metallic spherical shell has an inner radius R_1 and outer radius R_2. A charge Q is placed at the centre of the shell. What will be the surface charge density on the (i) inner surface, and (ii) outer surface of the shell?

CBSE-2019

353. Use Gauss's law to obtain the expression for electric field due to a thin infinitely long straight uniformly charged wire.

CBSE-2023

354. Use Gauss's law to obtain the expression for electric field due to a uniformly charged infinite plane thin sheet.

CBSE-2023

355. The electrostatic force on a small sphere of charge 0.4μC due to another small sphere of charge – 0.8μC in air is 0.2N. What is the distance between the two spheres?

Nagaland Board-2021

356. What is the force between two small charged spheres having charges of 2×10^{-7}C and 3×10^{-7}C placed 30 an apart in air?

Nagaland Board-2021

357. Define Gauss's law for electric flux.

Haryana Board-2017

358. Define Gauss's law for electric flux and write its relation.

Haryana Board-2016

359. State and explain Gauss's Law for magnetism.

Gujarat Board-2023

360. Derive an equation for and electric field due to infinitely long straight uniformly charged wire.

Gujarat Board-2023

372. A spherical conducting shell of inner radius R_1 and outer radius R_2 has a charge Q. A charge q is placed at the centre of the shell.

(i) What is the surface charge density on the
(a) inner surface,
(b) outer surface of the shell?

(ii) Write the expression for the electric field at a point to $x > R_2$ from the centre of the shell.

CBSE All India-2010

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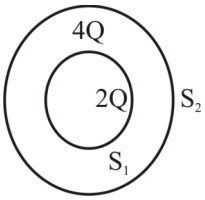
373.



Consider two hollow concentric spheres S_1 and S_2 enclosing charges 2Q and 4Q respectively, as shown in the figure. (i) Find out the ratio of the electric flux trough them. (ii) How will the electric flux through the spheres S_1 change if a medium of dielectric constant ε_r is introduced in the space inside S_1 in place of air? Deduce the necessary expression.

CBSE All India-2010 C

374. How does the electric flux due to a point charge enclosed by a spherical Gaussian surface get affected when its radius is increased?

CBSE Delhi-2016

375. What is the flux due to electric field $E = 3 \times 10^3\ \hat{\mathbf{i}}\ NC^{-1}$ through a square of side 10cm, when it is held normal to E?

CBSE All India-2015C

376. Two charges of magnitudes –2Q and +Q are located at points (a, 0) and (4a, 0), respectively. What is the electric flux due to these charges through a sphere of radius 3a with its centre at the origin?

CBSE All India-2013

377. A charge q is placed at the centre of a cube of side *l*. What is the electric flux passing through each face of the cube?

CBSE All India-2010
CBSE Foreign-2010

378. Given a uniform electric field $E = 5\times10^3\ \hat{\mathbf{i}}\ NC^{-1}$, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the YZ-plane. What would be the flux through the same square if the plane makes an angle of 30º with the X-axis?

CBSE Delhi-2014

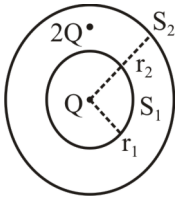
379. Given, a uniform electric field $E = 2 \times 10^3\ \hat{\mathbf{i}}\ NC^{-1}$, find the flux of this field through a square of side 20 cm, whose plane is parallel to the YZ-plane. What would be the flux through the same square, if the plane makes an angle of 30º with the X-axis?

CBSE Foreign-2014

380. Given a uniform electric field $E = 4 \times 10^3\ \hat{\mathbf{i}}\ NC^{-1}$. Find the flux of this field through a square of 5 cm on a side whose plane is parallel to the YZ-plane. What would be the flux through the same square if the plane makes an angle of 30º with the X-axis?

CBSE Delhi-2014C

381.



A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius r_2($r_2 > r_1$) enclosing charge 2Q, find the ratio of the electric flux through S_1 and S_2. How will the electric flux through sphere S_1 change if a medium of dielectric constant K is introduced in the sphere inside S_2 in place of air?

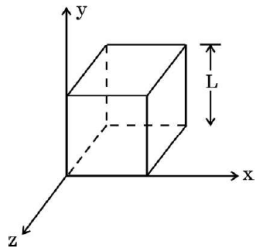
CBSE All India-2014

Section-C (Short Answer)

382. Use Gauss' law to obtain the expression for the electric field due to a uniformly charged infinite plane sheet.

CBSE-2023

383. A cube of side L is kept in space, as shown in the figure. An electric field $\vec{\mathbf{E}} = (\mathbf{Ax}+\mathbf{B})\hat{\mathbf{i}}\frac{\mathbf{N}}{\mathbf{C}}$ exists in the region. Find the net charge enclosed by the cube.



CBSE-2023

384. State Gauss' law in electrostatics. Apply it to find the expression for the electric field due to an in infinitely long straight charged wire.

Odisha Board-2020

385. Write Gauss's law of electrostatics and with its help derive the expression for electric field intensity near a uniformly charged straight wire of infinite length?

Uttarakhand Board-2023

386. Gauss's theorem is useful in determining the electric field when the source distribution has symmetry.

(a) The electric field intensity at a distance 'r' from a uniformly charged infinite plane sheet of charge is

(i) Proportional to r

(ii) Proportional to $\frac{1}{r}$

(iii) Proportional to $\mathbf{r^2}$

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(iv) Independent of **r**

(b) A thin spherical shell of radius 'R' is uniformly charged to a surface charge, density σ Using Gauss's theorem derive the expression for the electric field produced outside the shell.

Kerala Board-2016

387. Use Gauss's theorem to derive an expression for electric field due to a uniformly charged spherical shell at a point outside the shell.

Meghalaya Board-2013, 2019

388. Using Gauss's theorem in electrostatics, derive an expression for electric field at a point due to an infinitely long line of charge having a uniform charge density.

Meghalaya Board-2018

389. Using Gauss's theorem, derive an expression for an electric field at a point near a uniformly charged infinite plane sheet.

Meghalaya Board-2023
Rajasthan Board-2022
J&K Board-2019
Nagaland Board-2018
Assam Board-2014

390. Using Gauss's law derive an expression for electric field at a point near a thin uniformly charged infinite plane sheet. Draw necessary diagram.

Goa Board-2019

391. State Gauss' theorem and uses it to derive the Coulomb's inverse square law.

MP Board-2013, 2023
Bihar Board-2022
UP Board-2018

392. State and prove Gauss' Theorem.

MP Board-2015, 2017

393. Write and prove Gauss' law for a closed surface in an electric field.

MP Board-2019

394. Using Gauss's law, derive the expression for electric field intensity due to a uniformly charged solid cylinder at a point which lies–

(i) outside the cylinder
(ii) inside the cylinder
(iii) on the surface of the cylinder

Chhattisgarh Board-2018

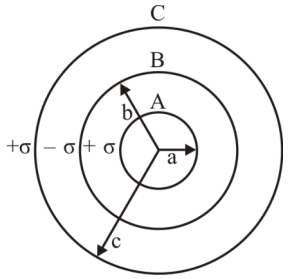
395. A charge Q is distributed over the surfaces of two concentric hollow spheres of radii r and R (R>> r), such that their surface charge densities are equal. Derive the expression for the potential at the common centre.

CBSE-2019

396. Three concentric metallic shells A, B and C of radii a, b and c (a < b< c) have surface charge densities + σ , – σ and + σ respectively as shown.

(a) Obtain the expressions for the potential of three shells A, B and C.

(b) If shells A and C are at the same potential, obtain the relation between a, b and c.



CBSE-2019

397. Two large charged plane sheets of charge densities σ and –2σ C/m^2 are arranged vertically with a separation of a between them. Deduce expressions for the electric field at points (i) to the left of the first sheet, (ii) to the right of the second sheet, and (iii) between the two sheets.

CBSE-2019

398. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q.

(a) A charge q is placed at the centre of the shell. Find out the surface charge density on the inner and outer surface of the shell.

(b) Is the electric field inside a cavity (with no charge) zero; independent of the fact whether the shell is spherical or not? Explain.

CBSE-2019

399. **(a)** **(i)** Use Gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density λ.

(ii) An infinitely long positively charged straight wire has a linear charge density λ. An electron is revolving in a circle with a constant speed v such that the wire passes through the centre, and is perpendicular to the plane, of the circle. Find the kinetic energy of the electron in terms of magnitudes of its charge and linear charge density λ on the wire.

(iii) Draw a graph of kinetic energy as a function of linear charge density λ.

CBSE-2023

400. Two charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of the electric fields at their surfaces

CBSE-2023

401. A hollow conducting sphere of inner radius r_1 and outer radius r_2 has a charge Q on its surface. A point charge –q is also placed at the centre of the sphere.

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(a) What is the surface charge density on the **(i)** inner and **(ii)** outer surface of the sphere?

(b) Use Gauss' law of electrostatics to obtain the expression for the electric field at a point lying outside the sphere.

CBSE-2020

402. **(a)** An infinitely long thin straight wire has a uniform linear charge density λ. Obtain the expression for the electric field (E) at a point lying at a distance x from the wire, using Gauss' law.

(b) Show graphically the variation of this electric field E as a function of distance x from the wire.

CBSE-2020

403. Using Gauss law, derive expression for electric field due to a spherical shell of uniform charge distribution σ and radius R at a point lying at distance x form the center of shell, such that

(i) $0 < x < R$, and

(a) $x > R$.

(b) An electric field is uniform and acts along +x direction in the region of positive x. It is also uniform with the same magnitude but acts in x - direction in the region of negative x. The value of the field is E = 200 N/C for x > 0 and E = –200 N/C for x < 0 A right circular cylinder of length 20 cm and radius 5 cm has its center at the origin and its axis along the x - axis so that one flat face is at x = +10 cm and the other is at x = –10 cm .

Find :

(i) The net outward flux through the cylinder.

(ii) The net charge present inside the cylinder.

CBSE-2020

404. Find an expression for the electric field at a point due to a line charge using Gauss's theorem.

J&K Board-2023

405. Find an expression for the electric field at any point outside a uniformly charged thin spherical shell.

J&K Board-2023

406. A charge Q is uniformly distributed on the circumference of a circular ring of radius a. Find the intensity of electric field at a point at a distance x from the centre on the axis of the ring.

Gujarat Board- March, 2019

407. State Gauss's theorem in electrostatics. Use this theorem to derive expressions for electric field due to uniformly charged thin spherical shell at a point (i) outside and (ii) inside the shell.

Jharkhand Board-2018

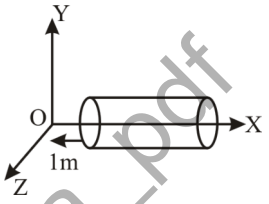
408. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q.

(a) A charge q is placed at the centre of the shell. Find out the surface charge density on the inner and outer surfaces of the shell.

(b) Is the electric field inside a cavity (with no charge) zero; independent of the fact whether the shell is spherical or not? Explain.

CBSE All India-2019

409. A hollow cylindrical box of length 1 m and area of cross section 25 cm^2 is placed in a three-dimensional coordinate system as shown in the figure. The electric field in the region is given by $E = 50\,\mathbf{x}\hat{\mathbf{i}}$, where E is in NC^{-1} and x is in metre.



(i) net flux through the cylinder.

(ii) charge enclosed by the cylinder.

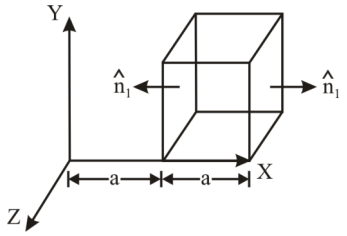
CBSE Delhi-2013

410. **(i)** State Gauss's law.

(ii) A thin straight infinitely long conducting wire of linear charge density λ is enclosed by a cylindrical surface of radius r and length *l*. Its axis coinciding with the length of the wire. Obtain the expression for the electric field, indicating its direction, at a point on the surface of the cylinder.

CBSE Delhi-2012

411. State Gauss' law in electrostatics. A cube with each side a is kept in an electric field given by $E = C\,\mathbf{x}\hat{\mathbf{i}}$ as shown in the figure, where C is a positive dimensional constant. Find out



(i) the electric flux through the cube.

(ii) the net charge inside the cube.

CBSE Foreign-2012

412. Using Gauss' law, obtain the expression for the electric field due to uniformly charged spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for r > R and r < R.

CBSE All India-2011

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413. Two large charged plane sheets of charge densities σ and -2σ C/m^2 are arranged vertically with a separation of d between them. Deduce expressions for the electric field at points (i) to the left of the first sheet, (ii) to the right of the second sheet and (iii) between the two sheets.

CBSE All India-2019

414. State Gauss's law. Using this, derive an expression for electric field due to an infinitely long straight charged wire with uniform charge density.

Manipur Board-2022
Tamil Nadu Board-September, 2016

Section-D (Case-Based Questions)

415. State Gauss' law. Use it to deduce the expression for the electric field due to a uniformly charged thin spherical shell at points.

(a) inside the shell and **(b)** outside the shell

CBSE All India-2011 C

416. Use Gauss' theorem to find the electric field due to a uniformly charged infinitely large plane thin sheet with surface charge densityσ.

CBSE All India-2017

417. **(a)** Use Gauss' law to derive the expression for the electric field (E) due to a straight uniformly charged infinite line of charge density λ C/m.

(b) Draw a graph to show the variation of E with perpendicular distance r from the line of charge.

(c) Find the work done in bringing a charge q from perpendicular distance r_1 to r_2 ($r_2 > r_1$)

CBSE-2018

Section-E (Long Answer)

418. Show that electric potential can be represented as line integrals of eclectics field.

J&K Board-2021

419. Using Gauss's law derive an expression for electric field due to uniformly charged thin spherical shell at a point outside the shell.

J&K Board-2020
Karnataka Board- March, 2019
Karnataka Board- July, 2019
Meghalaya Board-2013, 2019

420. Define electric dipole moment. Derive an expression for the electrical potential energy in rotating an electric dipole through an angle θ in a uniform electric field.

Manipur Board-2022

421. Using Gauss's law in electrostatics, obtain the expression for electric field due to a uniformly charged thin spherical shell at a point.

i) Outside the shell and

ii) Inside the shell

Karnataka Board-July, 2018

422. Derive an expression for electric field at a point due to a infinitely long thin charged straight wire using Gauss law.

Karnataka Board-July, 2016

423. State Gauss's law in electrostatics. Derive the expression for electric field at a point due to a infinitely long charge straight conductor using Gauss's law.

Karnataka Board-July, 2015

424. Derive an expression for electric field at a point outside the uniformly charged spherical shell placed in vacuum using Gauss law.

Karnataka Board-July, 2014
Karnataka Board-March, 2014

425. State Gauss law in electrostatics. Using the law derive an expression for electric field due to a uniformly charged thin spherical shell at a point outside the shell.

Karnataka Board-March, 2014
Karnataka Board-July, 2014

426. What is the net electric flux through a closed surface surrounding an electric dipole? Derive the expressions for electric field intensity both inside and outside a uniformly charged spherical cell. What is the total charge enclosed by a closed surface is the electric flux entering and leaving the surface are $20000\,{}^{N}\!/_{C^{m^2}}$ and $30000\,{}^{N}\!/_{C^{m^2}}$ respectively. Given $\epsilon_0 = 8.85\times10^{-12}\,C^2N^{-1}m^{-2}$.

Assam Board-2017

427. Gauss law in electrostatics relates electric flux with electric charge

(a) Electric flux and electric charge are scalar quantities. State whether this statement is true of false.

(b) State Gauss law in electrostatics.

(c) Using Gauss law derive an expression for the intensity of electric field at a point due to an infinitely long straight uniformly charged wire.

Kerala Board-2021

428. Gauss's law can be used to determinate electric field due to a charge distribution

(a) Below are some statements about Gauss's law Say Whether they are true or false.

(1) Gauss's law is valid only for symmetrical charge distributions.

(2) The electric field calculated by Gauss's law is the field due to charges inside the Gaussian surface.

(b) Apply Gauss's law to find the electric field due to an infinitely long plane sheet of charge.

(c) "There can be no net charge in a region in which the electric field is uniform at all points". Do you agree with this statement? Justify your answer.

Kerala Board-2013

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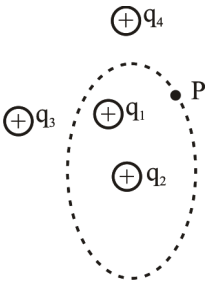
429. With the help of a diagram, obtain an expression for the electric field at a point outside a charged thin spherical shell.

The figure shows four positively charged particles. A Gaussian surface encloses q_1 and q_2:



(i) What is the net electric flux through the Gaussian surface?

(ii) Which of the particles shown, contribute to the electric field at point P on the surface?

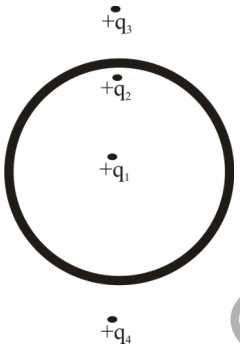
Goa Board-2023

430. Four charges $+q_1$, $+q_2$, $+q_3$ and $+q_4$ are placed as shown in the figure . $+q_1$ and $+q_2$ are enclosed by uniformly charged spherical shell.

Which charges experience.

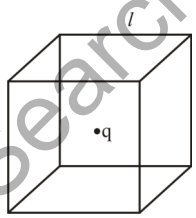
i) Maximum electrostatic force due to the shell?

ii)Minimum electrostatice force due to the shell?



Goa Board-2019

431.



A cube of side length 'l ' encloses a charge 'q' placed at its center as shown in the figure. What is the flux linked with one face of the cube? The plane of a square of side 10 cm makes an angle of 30º with the direction of an electric file, whose magnitude is 4×10^3 N/C . Determine the flux through the square.

Goa Board-2018

432. Using Gauss's theorem, find the expression for electric field intensity at a distance r from a uniformly charged spherical shell of radius R in the following situations:

(i) r > R

(ii) r = R

(iii) r < R

Chhattisgarh Board-2023

433. Write Gauss theorem and by using this theorem derive an expression for intensity of electric field at any point due to uniformly charged infinite plane sheet.

Chhattisgarh Board-2022

434. Find the intensity of the electric field due to the linear charge by the law of Gauss and prove that the electric field is inversely proportional to the distance.

Chhattisgarh Board-2021

435. Prove that the total electric flux associated with a closed surface is $\frac{1}{\varepsilon_0}$ times the total charge present inside the closed surface, where ε_0 is permittivity of free space. Write also name of the theorem. What will be the value of electric flux if the charge lies outside the closed surface?

Chhattisgarh Board-2020

436. Using Gauss's theorem, find the expression for electric field intensity at a distance r from a uniformly charged spherical shell of radius R in the following situations :

(i) r > R **(ii)** r = R **(iii)** r < R

Chhattisgarh Board-2019

437. N identical small charged drops coalesce to form a large drop. Find the following ratio of large drop and small drop.

(a) capacity

(b) potential

(c) charge

(d) electrostatic potential energy

UP Board-2018

438. What is Gauss' law ? Obtain the formula of electric field at a point outside the surface of a uniformly charged spherical shell with its help.

UP Board-2019

439. State Gauss' theorem in electrostatics. Using this theorem derive expression for electric field intensity near a uniform infinite charged non-conducting sheet.

UP Board-2021

440. 'Gauss's law is based on the inverse-square dependence on distance contained in the Coulomb's law'. Explain.

CBSE-2023

441. State Gauss's law on electrostatics and derive an expression for the electric field due to a long straight thin uniformly charged wire (linear charge density λ) at a point lying at a distance r from the wire.

CBSE-2020

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442. Use Gauss's law to show that due to a uniformly charged spherical shell of radius R, the electric field at any point situated outside the shell at a distance r from its centre is equal to the electric field at the same point, when the entire charge on the shell were concentrated at its centre. Also plot the graph showing the variation of electric field with r, for $r \le R$ and $r \ge R$.

CBSE-2020

443. State Gauss's law in electrostatics. Derive an expression for electric field due to a uniformly charged spherical shell at a point inside the shell.

J&K Board-2017

444. Explain the principle and working vale de Graff generator,

Or

Suite Gauss's theorem in electrostatics. Derive an expression for the electric field due to uniformly charged spherical shell at a point outside the shell

J&K Board-2016

445. State Gauss's Theorem. Use it to derive an expression for electric field at a point near an infinitely long straight charged wire.

J&K Board-2015

Tamil Nadu Board-2011

446. State Gauss's Theorem. Use it to derive an expression for electric field at a point near an infinitely long straight charged wire.

J&K Board-2014

447. Explain the construction and working of Van-de-Graff generator.

Or

State Gauss's theorem and derive an expression for the electric field of an infinite long line of charge having uniform charge density A.

J&K Board-2012

448. Stage Gauss's law. Derive an expression for the electric field due to an infinite line of charge.

Or

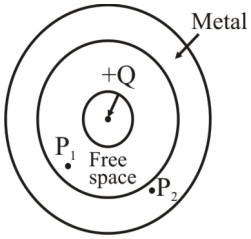
Give the principle. Construction and working of Van de Graff's generator.

J&K Board-2022

449. State Gauss law and write its mathematical formula. Using Gauss law, obtain an expression for electric field intensity at a point near to a uniformly charged infinite conducting sheet. Draw necessary diagram and show the variation of intensity of electric field with surface chare density by graph.

Rajasthan Board-2011

450. A small metal sphere carrying charge +Q is located at the centre of a spherical cavity inside a large uncharged metallic spherical shell as shown in the figure. Use Gauss' law to find the expressions for the electric field at points P_1 and P_2.



CBSE Delhi-2012C

451. Using Gauss' law, deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point.

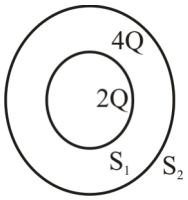
(i) outside the shell

(ii) inside the shell. Plot a graph showing variation of electric field as a function of r > R and r < R.

(r being the distance from the centre of the shell)

CBSE All India-2013

452.



Consider two hollow concentric spheres S_1 and S_2 enclosing charges 2Q and 4Q respectively as shown in the figure (i) find out the ratio of the electric flux through them. (ii) How will the electric flux through the sphere S_1 changes, if a medium of dielectric L is introduced in the space inside S_1 in place of air? Deduce the necessary expression?

CBSE All India-2014

453. Use Gauss' law to prove that the electric field inside a uniformly charged spherical shell is zero.

CBSE Delhi-2015

454. State Gauss's theorem. With the help of diagram, derive an expression for the electric field intensity due to uniformly charged thin spherical shell at a point **(i)** outside **(ii)** inside **(iii)** on the surface of the spherical shell.

Punjab Board-2018

455. State Gauss Law in electrostatics. Obtain an expression for Electric field due to an infinitely long charged wire.

Tamil Nadu Board-2023

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2. Electrostatic Potential and Capacitance

I. Electrostatic Potential, and Potential due to Charge, System of Charge and Electric Dipole, Equipotential Surface

Section-A (Multiple Choice Questions)

1. A charged particle is placed between the two plates of a charged parallel plate capacitor. It experiences a force F. If one plate is removed, then the force on the particle will be

(a) 2F (b) F (c) $\frac{F}{2}$ (d) Zero

CBSE-2020

Ans. (c) :

2. The equipotential surface an electric dipole is:

(a) a sphere whose centre coincides with the centre of the electric dipole
(b) a plane surface inclined at an angle of 45º with axis of the electric dipole
(c) a plane surface passing through the centre of the electric dipole and perpendicular to the axis of the electric dipole
(d) any plane surface parallel to the axis of the electric dipole

Tamil Nadu Board-March, 2016

Ans. (c) :

3. Two point charges $+q_1$ and $+q_2$ are placed in air at a distance of 2 m apart. One of the charges is moved towards the other through a distance of 1m. The work done is:

(a) $\frac{q_1q_2}{4\pi\varepsilon_0}$ (b) $\frac{2q_1q_2}{4\pi\varepsilon_0}$ (c) $\frac{q_1q_2}{8\pi\varepsilon_0}$ (d) $\frac{q_1q_2}{16\pi\varepsilon_0}$

Tamil Nadu Board-2015

Ans. (c) :

4. The work done in moving 500 μC charge between two points on equipotential surface is:

(a) zero (b) finite positive
(c) finite negative (d) infinite

Tamil Nadu Board-2015

Ans. (a) :

5. The force between two charges situated in a medium of permittivity 'ε' is :

(a) $\frac{\varepsilon}{4\pi}\frac{q_1q_2}{r^2}$ (b) $9\times10^9\,\varepsilon_r\frac{q_1q_2}{r^2}$

(c) $9\times10^9\frac{q_1q_2}{r^2}$ (d) $\frac{9\times10^9}{\varepsilon_r}\frac{q_1q_2}{r^2}$

Tamil Nadu Board-2016

Ans. (c) :

6. A charge of 5C is moved along on equipotential surface having a pot of 10 volts. The work done is

(a) 50J (b) 2J
(c) 0.5J (d) Zero

J&K Board-2015, 2014

Ans. (d) :

7. SI unit of electrostatic potential is:

(a) Ohm (b) Coulomb
(c) Volt (d) Ampere

Haryana Board-2017

Ans. (c) :

8. The dimensions of permittivity [ε_0] are ——. Take Q as the dimension of charge.

(a) $M^{-1}L^{-3}T^2Q^2$ (b) $M^{-1}L^2T^{-3}Q^{-1}$
(c) $M^1L^{-2}T^{-2}Q^{-2}$ (d) $M^{-1}L^3T^{-2}Q^{-2}$

Gujarat Board- May, 2021

Ans. (a) :

9. An electric dipole kept in uniform electric field at an angle "θ" has minimum potential energy. The value of "θ" is____.

(a) 90º (b) 45º
(c) 0º (d) 180º

Gujarat Board- August, 2020

Ans. (c) :

10. Equipotential surface through a point is —— to the electric field at that point.

(a) normal (b) parallel
(c) at an angle of 45° (d) at an angle of 30°

Gujarat Board- March, 2020

Ans. (a) :

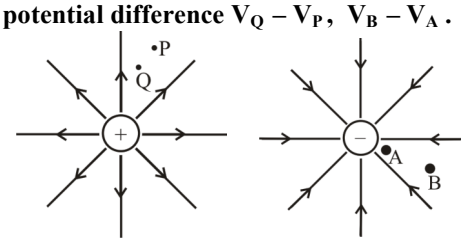
11. Equipotential surfaces at a very large distance from the collection of charges whose total sum is not zero are approximately _____.

(a) paraboloids (b) planes
(c) spheres (d) ellipsoid

Gujarat Board-2023

Ans. (c) :

12. Figure shows the field lines of a positive and negative charge respectively. Give the sign of potential difference $V_Q - V_P$, $V_B - V_A$.



(a) –ve, +ve (b) +ve, –ve
(c) +ve, +ve (d) –ve, –ve

Gujarat Board-2023

Ans. (c) :

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13. The electric potentials at two points (0, 3) mm and (0, 4) mm in the region in which electric field $\vec{E} = 20\hat{i}\ NC^{-1}$ are V_A and V_B respectively then,

(a) $V_A > V_B$
(b) $V_A < V_B$
(c) $V_A = V_B$
(d) None of the given choices

Gujarat Board-March, 2022

Ans. (a) :

14. The electric potential at a distance _____due to the charge 4×10^{-7} C is 4×10^{4} V.

(a) 9 cm (b) 9 mm
(c) 9 μm (d) 9 m

Gujarat Board-March, 2022

Ans. (a) :

15. The angle between electric lines of force and equipotential surface is:

(a) 0° (b) 180°
(c) 90° (d) 45°

MP Board-2014

Ans. (c) :

16. Two point charges, each of q, are placed at a separation of 2a, the electric potential at their midpoint will be :

(a) Zero (b) $\frac{q}{2\pi\varepsilon_0 a}$
(c) $\frac{q}{8\pi\varepsilon_0 a}$ (d) $\frac{q}{2\pi\varepsilon_0 a^2}$

MP Board-2016

Ans. (a) :

17. The potential due to a point charge Q at a point distant r from it is :

(a) inversely proportional to r
(b) inversely proportional to r^2
(c) directly proportional to r
(d) directly proportional to r^2

Bihar Board-2023
NIOS-2022

Ans. (a) :

18. An electron of mass 'm' and charge 'e' is moving from rest through a potential difference 'V' in vacuum. Its final velocity is :

(a) $\sqrt{\frac{2eV}{m}}$ (b) $\sqrt{\frac{eV}{m}}$
(c) $\frac{eV}{2m}$ (d) $\frac{eV}{m}$

J&K Board-2020

Ans. (a) :

19. The angle between an equipotential surface and electric line of force at a point is

(a) 0° (b) 90°
(c) 180° (d) 45°

Odisha Board-2022

Ans. (b) :

20. The electrostatic potential due to an electric dipole at distance r from its centre is directly proportional to

(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$
(c) $\frac{1}{r^3}$ (d) $\frac{1}{r^4}$

Odisha Board-2022

Ans. (b) :

21. The electric potential equatorial position of an electric dipole is-

(a) $\frac{1}{4\pi\varepsilon_0}\frac{p\cos\theta}{r^2}$
(b) $\frac{1}{4\pi\varepsilon_0}\frac{p}{r^2}$
(c) $\frac{1}{4\pi\varepsilon_0}\frac{P}{r}$
(d) Zero

Bihar Board-2019

Ans. (b) :

22. An angle between electric field lines and surface of a charged conductor is

(a) 0° (b) 30°
(c) 60° (d) 90°

Bihar Board-2021

Ans. (d) :

23. If a hollow spherical conductor is charged with positive charge, the potential inside it will be

(a) zero
(b) positive and uniform
(c) positive and non-uniform
(d) negative and uniform

Bihar Board-2022

Ans. (b) :

24. An electric dipole of dipole moment $\vec{p}$ is placed in a uniform electric field of strength $\vec{E}$. If θ is the angle between the positive direction of $\vec{p}$ and $\vec{E}$, then potential energy of the dipole is largest when θ is

(a) 0° (b) 90°
(c) 180° (d) 45°

Meghalaya Board-2019

Ans. (c) :

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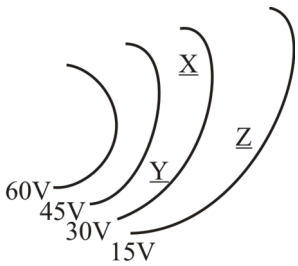
Section-B (Very Short Answer)

25. What is the shape of equipotential surface for a give point charge q.

Punjab Board-2018

26.



The above figure shows equipotential surfaces n in an electric field. At which of the Points X, Y and Z is the magnitude of the electric field the highest ? Why?

Goa Board-2018

27. Define electric potential at a point. obtain an expression for electric potential at a point due to a point charge.

Tamil Nadu Board-September, 2016

28. Find the electrostatic potential energy of an electric dipole having magnitude of each charge as 3×10^{-6} coulomb, separated by a distance of 2×10^{-7} metre.

J&K Board-2022

29. Write the value of electric potential at a distance r from the middle point of the dipole on the axis of the electric dipole of dipole moment p.

Rajasthan Board-2022

30. Derive an expression for the periodic time of simple harmonic motion of an electric dipole kept in a uniform magnetic field.

Gujarat Board-March, 2022

31. Show that the lines of forces are normal to an equi-potential surface.

UP Board-2018

32. Define equipoiential surface. Mention its two characteristics.

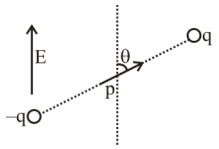
UP Board-2021

Jharkhand Board-2018

33. In an electric field a unit positive charge is displaced from one point to another point along a straight line of length 2cm and the work done is 2mJ. If it is displaced along a parabolic path between the same points of length 5cm, what will be the work done?

Assam Board-2017

34. A permanent electric dipole of dipole moment p is placed in a uniform external electric field E, as shown in Figure.



(a) Redraw the figure and show the magnitude and direction of force acting on the charges.

(b) Write an expression of the torque acting on this dipole in vector form.

Kerala Board-2020

35. Calculate the electric potential at a point 9.0 cm away form a point charge of 4×10^{-7} C.

Kerala Board-2021

36. All free charges are integral multiple of a basic unit charges. Then quantization rule of electric charge implies

(a) Q = e (b) $Q = \frac{1}{e}$

(c) Q = ne (d) $Q = e^2$

Kerala Board-2014

37. Match the following quantities in Column A with their units in Column B:

A	B
i) Force	a) Coulomb (C)
ii) Charge	b) N/C or V/M
iii) Electric field	c) oulomb meter (Cm)
iv) Dipole moment	d) Newton (N)

Kerala Board-2014

38. Obtain an expression for the torque on an electric dipole placed in a uniform electric field.

Meghalaya Board-2018

39. What is the direction of electric field with respect to an equipotential surface?

Meghalaya Board-2018

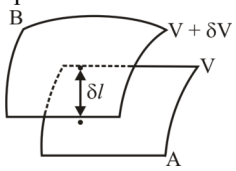
40. Two point charges 3μC and –3μC are placed at points A and B, 5 cm apart.

(i) Draw the equipotential surfaces of the system.

(ii) Why do equipotential surfaces get close to each other near the point charge?

CBSE All India-2011C

41. Two closely spaced equipotential surfaces A and B with potentials V and V + δV, (where δV is the change in V) are kept δ*l* distance apart as shown in the figure. Deduce the relation between the electric field and the potential gradient between them. Write the two important conclusions concerning the relation between the electric field and electric potential.



CBSE Delhi-2014C

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42. **(a)** Draw the equipotential surfaces due to an electric dipole.

(b) Derive an expression for the electric field due to a dipole of dipole moment p at a point on its perpendicular bisector.

CBSE Delhi-2019

43. **(a)** Draw equipotential surfaces corresponding to the electric field that uniformly increases in magnitude along with the z-directions.

(b) Two charges –q and +q are located at points (0, 0, –a) and (0, 0, a). What is the electrostatic potential at the points (0, 0, ± z) and (x, y, 0) ?

CBSE Delhi-2019

44. Name the physical quantity whose SI unit is JC^{-1}. Is it a scalar or a vector quantity?

CBSE All India-2010

45. Can two equipotentail surface intersect each other? Justify your answer.

CBSE Delhi-2011C

46. Why the potential inside a hollow spherical charged conductor is constant and has the same value as on its surface?

CBSE Foreign-2012

47. Why electrostatic potential is constant throughout the volume of the conductor and has the same value as on its surface?

CBSE Foreign-2012

48. Two charges 2μC and –2μC are placed at point A and B, 5 cm apart. Depict an equipotential surface of the system.

CBSE Delhi-2013C

49. What is the geometrical shape of equipotential surface due to a single isolated charge?

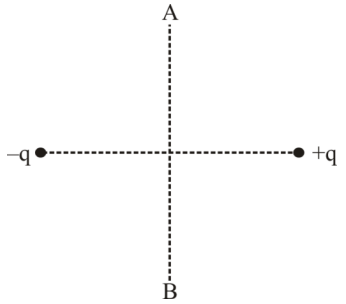
CBSE Delhi-2013

CBSE All India-2010 C

50. Two point charges q and –2q are kept d distance apart. Find the location of point relative to charge q at which potential due to this system of charges is zero.

CBSE All India-2014C

51. A charge q is moved from a point A above a dipole moment p to a point B below the dipole in equatorial plane without acceleration. Find the work done in this process.



CBSE All India-2016

52. Draw the equipotential surfaces due to an isolated point charge.

CBSE Delhi-2019

CBSE All India-2011C

53. The angle between electric line of force and equipotential surface is _____.

Odisha Board-2020

54. Force of attraction between two point electric charge placed at a distance d in a medium is F. What distance apart should these be kept in the same medium, so that force between them becomes $\frac{F}{3}$?

Manipur Board-2022

55. What is an equipotential surface ?

Manipur Board-2022

Karnataka Board-July, 2018

56. What is an electric dipole?

Karnataka Board-March, 2016

57. Derive an expression for the electric potential due to a point charge.

AP Board-2023

58. What do you mean by equipotential surface?

Bihar Board-2021

59. What do you mean by electric potential at a point ?

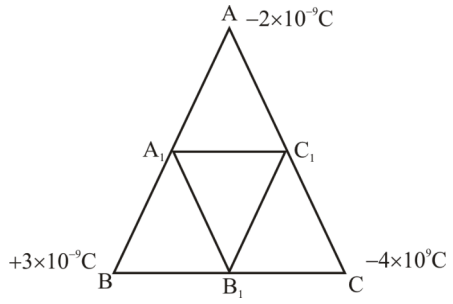
Bihar Board-2021

60. Establish a relationship between electric potential and electric field.

Nagaland Board-2018

Section-C (Short Answer)

61. Three charges -2×10^{-9}C. $+3\times10^{-9}$ C and -4×10^{-9} C are placed at the vertices of an equilateral triangle ABC of side 20 cm. Calculate the work done in shifting the charges from A, B and C to A_1, B_1 and C_1 respectively. Which are the mid-points of the sides of triangle?



Tamil Nadu Board-2011

62. Write the definition of electric dipole. An electric dipole is placed in a uniform external electric field $(\vec{E})$ as shown in the figure. Calculate the torque on this electric dipole.

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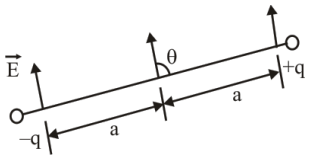


Rajasthan Board-2022

63. Derive the formula for the electric potential energy of an electric dipole in an uniform electric field. Discuss its stable and unstable equilibrium state.

Gujarat Board- March, 2019

64. What is electric potential? Deduce an expression for the potential at a point due to a point charge.

MP Board-2021

65. **(a)** Define electric dipole moment.

(b) A system has two charges 2.5×10^{-7} C and -2.5×10^{-7} C located at points (0, 0, –15 cm) and (0, 0, +15 cm), respectively. Determine the magnitude and direction of electric dipole moment of the system.

Kerala Board-2021

66. What is an equipotential surface? Show that work done in moving a charge on an equipotential surface is zero.

Meghalaya Board-2015

67. An electric dipole consists of two opposite charges of magnitude 1 μC each, separated by a distance of 3 cm. The dipole is placed in a uniform electric field of 4×10^5 N/C. Find the maximum torque on the dipole.

Meghalaya Board-2014

68. Obtain an expression for the electric field $\vec{E}$ at a distance 'r' form the centre of the electric dipole on its axial line. Draw necessary diagram.

Goa Board-2019

69. Show that the capacitance of a spherical conductor is $4\pi\varepsilon_o$ times the radius of the spherical conductor.

CBSE Delhi-2010

70. Define an equipotential surface. Draw equipotential surfaces.

(i) in case of a single point charge

(ii) in a constant electric field in Z-direction. Why the equipotential surfaces about a single charge are not equidistant?

(iii) Can electric field exist tangential to an equipotential surface? Give reason.

CBSE All India-2005

71. **(i)** Depict the equipotential surfaces for a system of two identical positive point charges placed a distance d apart.

(ii) Deduce the expression for the potential energy of a system of two point charges q_1 and q_2 brought from infinity to the points with positions r_1 and r_2 respectively, in presence of external electric field E.

CBSE Delhi-2010

72. **(i)** Derive the expression for the electric potential due to an electric dipole at a point on its axial line.

(ii) Depict the equipotential surfaces due to an electric dipole.

CBSE Delhi-2017

Karnataka Board-March, 2016

Haryana Board-2016

73. **(a)** Draw the equipotential surfaces corresponding to a uniform electric field in the z-direction.

(b) Derive an expression for the electrical potential at any point along the axial line of an electric dipole.

CBSE Delhi-2019

74. Derive an expression for potential energy of electric – dipole placed in an uniform electric field.

Karnataka Board-March, 2019

75. Derive the relation between electric field and electric potential due to point charge.

Karnataka Board-July, 2014, 2015

76. Establish the relation between electric field electric Potential.

Karnataka Board-July, 2020

Section-D (Long Answer)

77. What are electric dipole and electric dipole moment? Calculate the work done in rotating an electric dipole kept in uniform electric field by an angle θ_o from its stable equilibrium state. If value of rotating angle (θ_o) becomes 90° and 180°, then what will be the value of work done? Draw necessary diagram.

Rajasthan Board-2011

78. Define electric potential at a point. Obtain an expression for the electrostatic potential due to an electric dipole.

Nagaland Board-2017

79. Derive an electric potential at a distance r(r >> a) due to an electric dipole. Also write potential on the axis and in the equatorial plane.

Gujarat Board-March, 2022

80. Deduce the electric potential at any point due to point charge.

MP Board-2017

81. Explain the physical process on the basis of which the r.m.s. value of AC is defined. Derive the expression for rms value of an alternating voltage. How does the value of Capacitative reactance of a capacitor change with the frequency of the applied alternating emf across it.

Assam Board-2017

82. What does $q_1 + q_2 = 0$ signify in lectrostatics ?

Meghalaya Board-2021

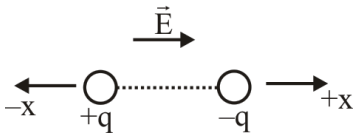
SearchOn TG: @apna_pdf

83. Two point charges –q and +q separated by a short distance 2a are placed in free space at points A and B respectively. Derive an expression for the electric potential at a point P whose distance from the centre O of the line AB is r and OP makes an angle q with the electric dipole moment $\vec{p}$. Hence, find the potential if P lies on (i) axial line and (ii) equatorial line.

Meghalaya Board-2014

84. With the help of a diagram, obtain an expression for the electric field of an electric dipole at a point on its equatorial plane.

The figure shows an electric dipole placed along X- axis in an external non- uniform electric field, increasing in + x direction.



(i) What is the direction of the force experienced by the charge (–q) ?

(ii) What is the direction of the net force experienced by the dipole?

Goa Board-2023

85. What is Electric Potential? Derive an expression for electric potential at a distance from a charge 'q'.

J&K Board-2011

86. Define electric field and electric potential at a point. Derive the expression for the electric field due to an electric dipole at an equatorial point.

Odisha Board-2020

Karnataka Board-July, 2019

Karnataka Board-March, 2015

87. Define 'electric dipole' and 'dipole moment', Derive expressions for the electric field intensity and electric potential due to a dipole at a point on its axis.

Odisha Board-2022

88. Derive an expression for the electric field at a point on the equatorial line of electric dipole.

Karnataka Board-July, 2020

89. Write the definition and unit of Electric Potential. Two point charges 0.12μC and – 0.06 μC respectively are situated mutually at the distance of 3.0 metre Find the electric potential at the mid-point P of both. How much work will be done to bring another charge of 0.2 μC from infinity to mid-point P.

Uttarakhand Board-2022

90. What is electric dipole? Find an expression for electric potential at any point due to an electric dipole.

Bihar Board-2019

II. Electric Potential Energy and Potential Energy in External Field

Section-A (Multiple Choice Questions)

91. The electric potential energy (U) of two point charges is

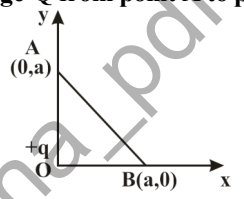
(a) $\frac{q_1q_2}{4\pi\varepsilon_0 r^2}$ (b) $\frac{q_1q_2}{4\pi\varepsilon_0 r}$

(c) $pE\cos\theta$ (d) $pE\sin\theta$

Tamil Nadu Board-2011

Ans. (b) :

92. In the given diagram a point charge +q is placed at the origin O. Work done in taking another point charge-Q from point A to point B is:



(a) $\frac{qQ}{4\pi\epsilon_0 a^2}\left(\frac{a}{\sqrt{2}}\right)$ (b) Zero

(c) $\left[\frac{-qQ}{4\pi\epsilon_0}\frac{1}{a^2}\right]\sqrt{2}\,a$ (d) $\left[\frac{qQ}{4\pi\epsilon_0}\frac{1}{a^2}\right]\sqrt{2}\,a$

Tamil Nadu Board-2023

Ans. (b) :

93. The energy density of electric field $\vec{E}$ is :

(a) $\epsilon_o E^2$ (b) $2\epsilon_o E^2$

(c) $\frac{1}{2}\epsilon_o E^2$ (d) Zero

Haryana Board-2016

Ans. (c) :

94. A particle having mass 1 g and electric charge 10^{-8}C travels from a point A having electric potential 600 V to the point B having zero potential. What would be the change in its kinetic energy?

(a) –60 erg (b) -6×10^{-6} erg

(c) 60 erg (d) 6×10^{-6} erg

Gujarat Board- March, 2019

Ans. (c) :

95. The electric potential energy of 2μC charge is 3×10^{-5} J at a point in a uniform electric field. The electric potential at that point is ___V.

(a) 5 (b) 15

(c) 6 (d) zero

Gujarat Board-2023

Ans. (b) :

Search On TG: @apna_pdf

96. An electron is accelerated by a potential difference of $\Delta V = 2$ volts. The energy gained by it would be _____eV.

(a) 1.5 eV (b) 1 eV
(c) 2 eV (d) 0.5 eV

Gujarat Board-March, 2022

Ans. (c) :

97. If the distance between two plates of a parallel plate capacitor is halved, its capacity

(a) increases 2 times (b) decreases 2 times
(c) increases 4 times (d) decreases 4 times

Jharkhand Board-2023
Kerala Board-2020

Ans. (a) :

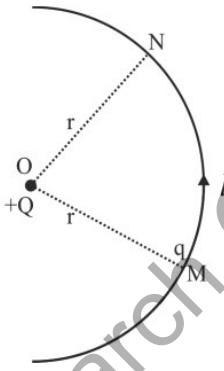
98. The electrostatic potential energy of two point charges, 1 μC each, place 1 m apart in vacuum is

(a) 9×10^3 J (b) 9×10^9 J
(c) 9×10^{-3} J (d) 9×10^{-3} eV

Jharkhand Board-2018
ISC-2017

Ans. (c) :

99. In the given figure below, a charge Q is fixed. Another charge q is moved along a circular arc MN of radius r around it, from the point M to the point N such that the length of the arc MN = *l*. The work done in this process is



(a) zero (b) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Qq}{r^2} l$
(c) $\frac{Qq}{2\varepsilon_0 r^2} l$ (d) $\frac{Qq}{2\pi\varepsilon_0 r^2}$

ISC-2016

Ans. (a) :

100. The ratio of the electric field intensity due to an electric dipole at an axial point to that at an equatorial point at same distance from the centre is

(a) 1:1 (b) 2:1
(c) 1:2 (d) 1:4

Odisha Board-2020

Ans. (b) :

101. Electric potential V and electric field intensity $\vec{E}$ are related as

(a) $\vec{E} = \vec{\nabla} V$ (b) $\vec{E} = -\vec{\nabla} V$
(c) $V = \vec{\nabla} . \vec{E}$ (d) $V = -\vec{\nabla} . \vec{E}$

Odisha Board-2022

Ans. (b) :

102. S.I. unit of gradient of potential is

(a) Nm^{-1} (b) Fm^{-1}
(c) mF^{-1} (d) Vm^{-1}

Bihar Board-2021

Ans. (d) :

103. Two point charges of +10μC and –10μC are placed at a distance of 40 cm in air. What will be the electric potential energy of the system ?

(a) 2.25 joule (b) 2.35 joule
(c) –2.25 joule (d) –2.35 joule

Bihar Board-2022, 2019

Ans. (c) :

104. If the distance between the two charge is increased, then the electrostatic potential energy of the charges

(a) decreases
(b) increases
(c) may increase or decrease
(d) remains the same

Bihar Board-2023

Ans. (c) :

Section-B (Very Short Answer)

105. Three charges + 1 μC,+3μC and –5μC are kept at the vertices of an equilateral triangle of sides 60 cm. Find the electrostatic potential energy of the system of charges.

Tamil Nadu Board-March, 2016

106. Why the potential of earth is considered to be zero? Explain the meaning of positive and negative potential.

Chhattisgarh Board-2022

107. In an electric dipole, at which point is the electric potential zero ?

ISC-2016

108. Two point charges of 10 C each, are kept at a distance of 3m in vacuum. Calculate their electrostatic potential energy.

ISC-2015

109. How much work is done in taking an electron around a nucleus in a circular path ?

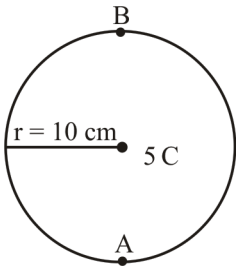
ISC-2011

110. How much kinetic energy is gained by an electrons initially at rest, when it moves through a potential difference of 1000V ? Give your answer in joule.

ISC-2008

Search On TG: @apna_pdf

111. A charge of 5C is placed at the centre of a circle of radius 10cm as shown in the figure alongside. Calculate the work done in moving a charge of 2C from point A to B on the circumference of the circle.



ISC-2005

112. An electron revolves around the nucleus of hydrogen atom in a circular orbit of radius 5×10^{-11}m. Calculate

(i) intensity of electric field of the nucleus at the position of the electron.

(ii) electrostatic potential energy of the hydrogen nucleus and electron system.

ISC-2010

113. If electric field E = 0 in a region do you think potential at the region should also be zero? Justify your answer.

Assam Board-2013

114. Define one electron volt.

Assam Board-2013

115. The work done in moving a charge 2×10^{-9} C from a point of potential –3kV to another point P is 5×10^{-5} J. Find the potential at point P.

Assam Board-2016

116. Find out the expression for the potential energy of a system of three charges q_1, q_2 and q_3 located at r_1, r_2 and r_3 with respect to the common origin O.

CBSE Delhi-2010C

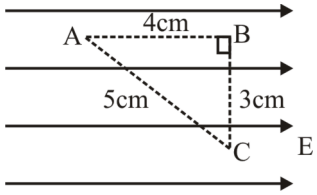
117. Draw a plot showing the variation of (i) electric field (E) and (ii) electric potential (V) with distance r due to a point charge Q.

CBSE Delhi-2012

118. A test charge q is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in the figure.

(i) Calculate the potential difference, between A and C.

(ii) At which point (of the two), the electric potential is more and why?



CBSE All India-2012

119. Two point charges q_1 and q_2 are located at r_1 and r_2, respectively in an external electric field E. Obtain the expression for the total work done in assembling this configuration.

CBSE Delhi-2014C

120. A hollow metal sphere of radius 5 cm is charged such that potential on its surface is 10V. What is the potential at the centre of the sphere?

CBSE All India-2011

122. Why there is no work done in moving a charge from one point to another on an equipotentail surface ?

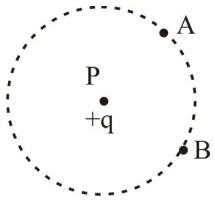
CBSE Foreign-2012

121. What is the amount of work done in moving a point charge around a circular arc of radius r at the centre of which another point charge is located?

CBSE All India-2013C

Section-C (Short Answer)

122. A positive charge +q is located at a point. P What would be the value of the work done if another point charge +q, is taken from point A to points B on the circumference of a circle drawn about the point P? why?



Goa Board-2023

123. Derive an expression for potential energy of a system of the external electric field.

Karnataka Board-July, 2016

Karnataka Board-March, 201

124. Derive an expression for the potential energy of an electric dipole in a uniform electric field. Explain conditions for stable and unstable equilibrium.

CBSE-2019

125. Find the expression for electric field intersity E due to a uniformly charged thin spherical shell at a point outside the shell.

Haryana Board-2018

126. Two charges 5×10^{-8}C and -3×10^{-8}C are located 16 cm apart. At what points on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero.

Gujarat Board- July, 2022

127. Find the expression for the potential energy of an electric dipole placed in uniform electric field. When maximum value of potential energy is obtained?

UP Board-2021

Search On TG: @apna_pdf

128. Obtain an expression for the electric potential at a point which is at a distance r from the point charge Q.

Karnataka Board-July, 2018
ISC-2008

(OR)

Find an expression for potential at a point due to a point charge.

Assam Board-2013

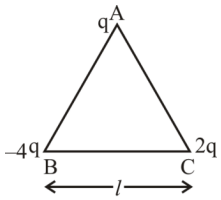
129. Three equal charge of 5.0 μC each are placed at the three vertices of an equilateral triangle of side 5.0 cm each. Calculate the electrostatic potential energy of the system of charges.

ISC-2007

130. Calculate the potential energy in case of dipole having magnitude of each charge as 3×10^{-6} C. The charges are separated at a distance of 2000 Å.

J&K Board-2020

131. **(a)** Three point charges q, –4q and 2q are placed at the vertices of an equilateral triangle ABC of side l as shown in the figure. Obtain the expression for the magnitude of the resultant electric force acting on the charge q.



(b) Find out the amount of the work done to separate the charges at infinite distance.

CBSE-2019

132. Establish the relation between electric field and electric potential.

Karnataka Board-March, 2020, 2017

133. Derive the expression for potential energy of a system of two charges in the absence of the external electric field.

Karnataka Board-July, 2016
Karnataka Board-March, 2014

Section-D (Long Answer)

134. Show that electric potential at a point P, at a distance r from a fixed point charge Q is given by

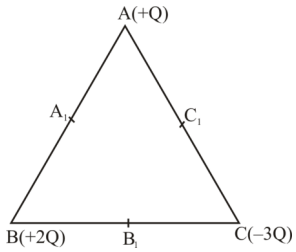
$$V = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{Q}{r}$$

ISC-2017

135. Three point charges $Q_1 = 25\mu C$, $Q_2 = 50\mu C$ and $Q_3 = 100\mu C$ are kept at the corners A, B and C respectively of an equilateral ΔABC having each side equal to 7.5 m. Calculate the total electrostatic potential energy of the system.

ISC-2012

136. Three point charges +Q, +2Q and –3Q are placed at the vertices of an equilateral triangle ABC of side I. If these charges are displaced to the midpoints A_1, B_1 and C_1 respectively, find the amount of work done in shifting the charges to the new locations.



Goa Board-2019

III. Electrostatics of Conductors, Dielectrics and Polarisation

Section-A (Multiple Choice Questions)

137. When a dielectric slab is introduced between the plates of a charged parallel plate capacitor, its:

(a) potential increases
(b) electric field decreases
(c) charge increases
(d) capacitance decreases

Tamil Nadu Board-March, 2016

Ans. (b) :

138. Valve of dielectric strength for air is ——Vm^{-1}

(a) 3×10^6 (b) 3×10^4
(c) 6×10^3 (d) 4×10^3

Gujarat Board- March, 2020

Ans. (a) :

139. The unit of conductance of the material of the given conductor is_____

(a) volt (b) $\frac{\text{volt}}{\text{ampere}}$
(c) $\frac{\text{volt}}{\text{metre}}$ (d) $\frac{\text{ampere}}{\text{volt}}$

Gujarat Board- March, 2019

Ans. (d) :

140. The potential difference between the two plates of a parallel plate condenser is constant, when air between the plates is replaced by dielectric material, the electric field intensity:

(a) decreases (b) remains unchanged
(c) becomes zero (d) increases

MP Board-2013

Ans. (a) :

141. The dielectric constant of air is-

(a) $8.85 \times 10^{-12}\ C^2N^{-1}M^{-2}$ (b) 1
(c) Infinite (d) Zero

MP Board-2015

Ans. (b) :

Search On TG: @apna_pdf

142. The dielectric constant (k) of silver is

(a) k = 0 (b) k = +1

(c) k = –1 (d) k = ∞(infinity)

UP Board-2023

Ans. (b) :

143. Capacity of a spherical conductor or radius 'R' is

(a) $C = \frac{1}{4\pi \in_0}.R$ (b) $C = 4\pi \in_0 .R$

(c) $C = \frac{4\pi \in_0}{R}$ (d) $C = \frac{1}{4\pi \in_0}.R^2$

Bihar Board-2021

Ans. (b) :

144. The value of dielectric constant for vacuum is

(a) 2.3 (b) 3.5

(c) 1 (d) zero

Bihar Board-2021

Ans. (c) :

145. The dielectric constant of metal is

(a) 0 (b) ∞

(c) 1 (d) –1

Bihar Board-2022

Ans. (b) :

146. The motion of electron inside the conductor is

(a) Uniform (b) Accelerated

(c) Drifting (d) Decelerated

Bihar Board-2023

Ans. (c) :

Section-B (Very Short Answer)

147. Define dielectric constant of a medium.

Assam Board-2016

148. What is meant by the capacitance of a conductor? Which factors affect the capacitance of a conductor and how?

MP Board-2021

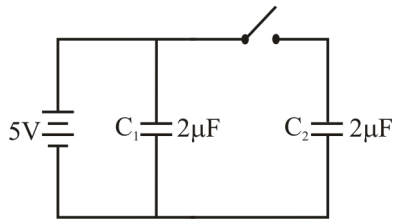
149. What are polar dielectrics and non polar dielectrics?

Maharashtra Board-2022

150. Distinguish between polar and non-polar dielectric.

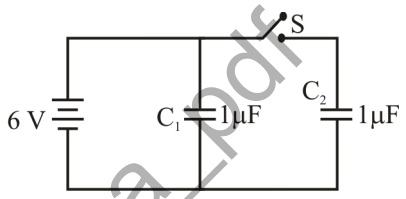
CBSE All India-2010C

151. Figure shows two identical capacitors C_1 and C_2, each of 2μF capacitance, connected to a battery of 5V. Initially, switch S is closed. After sometime, S is left open and dielectric slabs of dielectric constant K = 5 are inserted to fill completely the space between the plates of the two capacitors. How will the (i) charges and (ii) potential difference between the plates of the capacitor be affected after the slabs are inserted?



CBSE All India-2011; CBSE Delhi-2011

152. Two capacitors of 1μF capacitance are connected to a battery of 6V. Initially switch S is closed. After sometime S is left open and dielectric slab of dielectric constant K = 3 are inserted to fill completely the space between the plates of the two capacitors. How will the (i) charge and (ii) potential difference between the plates of the capacitors be affected after the slabs are inserted?



CBSE Delhi-2011

153. A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor, but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

CBSE Delhi-2013

154. Define the dielectric constant of a medium. What is its unit?

CBSE Delhi-2011C

155. Distinguish between a dielectric and a conductor.

CBSE Delhi-2012

156. Define dielectric constant in terms of capacity of a parallel plate capacitor.

Karnataka Board-July, 2020

157. What is electrostatic shielding? How can it be achieved.

Assam Board-2016

Section-C (Short Answer)

158. (a) (i) What do you understand by capacitance of a capacitor ? Write the relation between farad (F) and picofarad (pF). Obtain an expression for capacity of a parallel plate air capacitor. Do you think that dielectric has important effects on capacity of a condenser ?

Assam Board-2023

159. Calculate the force per unit length between two parallel straight wires 1 an apart in air each carrying a current of 2 amperes.

J&K Board-2017

Search On TG: @apna_pdf

160. How will the electrostatic potential energy be changed and why when a dielectric slab of dielectric constant k is introduced between the plates of a parallel plate capacitor which is disconnected from the battery ?

UP Board-2018

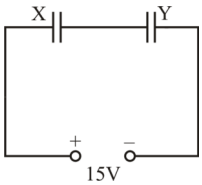
161. The diameter of parallel plate condenser is 6 cm and it is filled with air as dielectric. If capacity of this condenser be the same as that of a sphere of diameter 200 cm, then find the distance between its plates.

UP Board-2022

162. Obtained the expression for the energy stored per unit volume in a charged parallel plate capacitor.

CBSE Delhi-2014

163. Two parallel plate capacitors X and Y have the same separation between them, X has air between the plates while Y contains a dielectric medium of $\varepsilon_r = 4$.



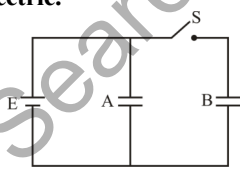
(i) Calculate the capacitance of each capacitor, if equivalent capacitance of the combination is 4μF.

(ii) Calculate the potential difference between the plates of X and Y.

(iii) Estimate the ratio of electrostatic energy stored in X and Y.

CBSE Delhi-2005

164. Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S is closed. The switch is now opened and **the free space between the plates of the capacitors is filled with a dielectric of dielectric constant K. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.**



CBSE All India-2017

165. Obtain the expression for effective capacitance of two capacitors connected in series.

Karnataka Board-July, 2018

Section-D (Long Answer)

166. Prove that two parallel conductors of infinite lengths. Carrying currents in the same direction attract each other. Deduce the expression for the force per unit length experienced by each conductor.

J&K Board-2016

167. **(B)** A parallel plate air condenser has a capacity of 20 μF. What will be the new capacity if :

(a) the distance between the two plates is doubled?

(b) a marble slab of dielectric constant 8 is introduced between the two plates?

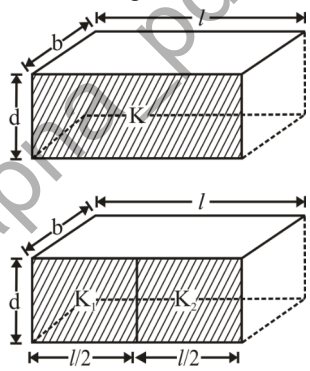
Maharashtra Board-2018

168. Find the force between two Parallel conductors carrying current in Same and Opposite direction and hence define one ampere.

J&K Board-2021

169. **(a)** Obtain the expression for the potential due to an electric dipole of dipole moment P at a point r on the axial line.

(b) Two identical capacitors of plate dimensions $l \times b$ plate separation d have dielectric slabs filled in between the space of the plates as shown in the figure.



Obtain the relation between dielectric constants K, K_1 and K_2

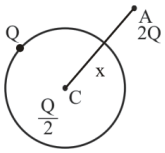
CBSE All India-2013

170. **(i)** Explain using suitable diagrams, the difference in the behaviour of a

(a) conductor and

(b) dielectric in the presence of external electric field. Define the terms polarisation of a dielectric and write its relation with susceptibility.

(ii) A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge Q/2 is placed at its centre C and another charge +2Q is placed outside the shell at a distance x from the centre as shown in the figure. Find



(a) the force on the charge at the centre of shell and at the point A,

(b) the electric flux through the shell.

CBSE All India-2015

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IV. Capacitor and Capacitance, Parallel Plate Capacitor

Section-A (Multiple Choice Questions)

171. 64 identical drops each of capacity 5μF combine to form a big drop. What is the capacity of the big drop ?
(a) 25μF (b) 4μF
(c) 164μF (d) 20μF
Bihar Board-2022

Ans. (d) :

172. Which of the following does not allow d.e. to pass through?
(a) Resistor (b) Capacitor
(c) Inductor (d) All of these
Tamil Nadu Board-2011

Ans. (b) :

173. If voltage applied on a capacitor is increased from V to 2 V choose the correct conclusion.
(a) Both Q and C remain the same
(b) Q remains the same, C is doubled
(c) Q is doubled, C is doubled
(d) C remains the same Q is doubled
Tamil Nadu Board-2023

Ans. (d) :

174. Three capacitors of equal capacity C are joined first in parallel and then in series. The ratio of equivalent capacities in both the cases will be:
(a) 9 : 1 (b) 6 : 1
(c) 3 : 1 (d) 1 : 9
Haryana Board-2022

Ans. (a) :

175. _____ m^2 is the area for a parallel plate capacitor having capacitance 8.85 μF. Plates are kept at distance of 1mm.
(a) 1×10^3 (b) 10
(c) 1 (d) 1×10^2
Gujarat Board- August, 2020

Ans. (a) :

176. The capacitance of a parallel-plate capacitor with vacuum is 5 μF. If a dielectric slab with K=1.5 is inserted between the plates, the capacitance will be equal to_____
(a) 0.75 μF. (b) 7.5 μF.
(c) 3.33 μF. (d) 0.33 μF.
Gujarat Board- August, 2020

Ans. (b) :

177. For a capacitor the distance between two plates is 4x and the electric field between them is E_0. Now a dielectric slab having dielectric constant 3 and thickness x is placed between them in contact with one plate. In this condition what is the p.d. between its two plates?
(a) $\frac{11E_0x}{3}$ (b) $\frac{13E_0x}{3}$
(c) $\frac{10E_0x}{3}$ (d) $\frac{9E_0x}{3}$
Gujarat Board- March, 2019

Ans. (c) :

178. S.I. unit of electrical capacity :
(a) Stat Farad (b) Farad
(c) Coulomb (d) Stat Coulomb
MP Board-2012

Ans. (b) :

179. The S.I. unit of electrical capacitance is –
(a) Coulomb (b) Stat Farad
(c) Stat Coulomb (d) Farad
MP Board-2021, 2012
Uttarakhand Board-2020

Ans. (b) :

180. The value of equivalent capacitance between points A and B of the circuit

will be :
(a) 1 μF (b) 3 μF
(c) $\frac{1}{3}$μF (d) $\frac{3}{2}$μF
Chhattisgarh Board-2018

Ans. (b) :

181. When the space between the plates of a capacitor having air is filled with a material of dielectric constant 6, its capacitance becomes :
(a) 6 times (b) 1/6 times
(c) 36 times (d) 1/36 times
NIOS-2017

Ans. (a) :

182. The dimension of electric permittivity is
(a) $[M^{-1}L^{-2}T^3A^2]$ (b) $[M^{-1}L^{-3}T^4A^2]$
(c) $[ML^2T^{-1}A^{-2}]$ (d) $[M^2LT^{-2}A^3]$
Odisha Board-2023

Ans. (b) :

183. If the area of each plate of a parallel-plate capacitor of capacitance C is doubled, its capacitance becomes
(a) 2C (b) 4C
(c) C/2 (d) C
Odisha Board-2022

Ans. (a) :

184. The relation between capacity of a conductor and its area is
(a) $C \propto A$ (b) $C \propto A^2$
(c) $C \propto \frac{1}{A}$ (d) $C \propto \frac{1}{A^2}$
Bihar Board-2021

Ans. (a) :

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185. Expression for electric potential energy stored in a capacitor is

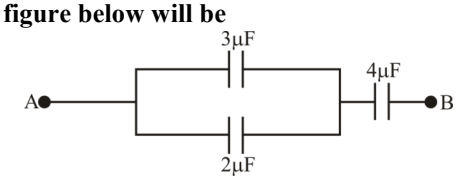
(a) $\frac{1}{2}CV^2$ (b) CV^2

(c) $\frac{1}{3}CV^2$ (d) $\frac{1}{4}CV^2$

Bihar Board-2021

Ans. (a) :

186. The equivalent capacity between A and B in the figure below will be



(a) 9μF (b) 1μF

(c) $\frac{20}{9}\mu F$ (d) $\frac{1}{9}\mu F$

Bihar Board-2022

Ans. (c) :

187. The quantity, which is same for each condenser for parallel grouping of condensers is

(a) charge (b) energy

(c) potential difference (d) capacity

Bihar Board-2022

Ans. (c) :

188. 64 identical drops each of capacity 5 μF combine to form a big drop. What will be the capacity of the big drop ?

(a) 25 μF (b) 4 μF

(c) 164 μF (d) 20 μF

Bihar Board-2023

Ans. (d) :

189. The net charge on a charged capacitor is

(a) zero (b) 1 μ C

(c) 1 C (d) infinite

Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

190. Describe the electric field and electric potential inside the charged conductor.

MP Board-2022

191. On what two factors does the capacity of a condenser depend ?

Bihar Board-2023

192. An A.C. source with variable frequency is connected to a parallel plate capacitor. How will the displacement current be affected with the decrease in frequency of the source?

CBSE-2020

193. Define capacitance of a conductor. What is its unit?

Meghalaya Board-2015

194. What are the applications of capacitors?

Tamil Nadu Board-September, 2016

195. The plates of a parallel plate capacitor have an area of $90cm^2$ each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400V supply. How much electrostatic energy is stored by the capacitor?

Tamil Nadu Board-March, 2016

196. If the area of each conducting plate of parallel plate capacitor is A & d is the separation between them, then derive its capacitance formula.

Rajasthan Board-2022

(OR)

Derive an expression for the capacitance of a parallel plate capacitor.

Meghalaya Board-2023
Gujarat Board- July, 2022
AP Board-2022, 2020
Gujarat Board- March, 2020
Jharkhand Board-2019
Telangana Board-2018
Kerala Board-2017
Tamil Nadu Board-2017, 2015
Karnataka Board-March, 2015
Assam Board-2014

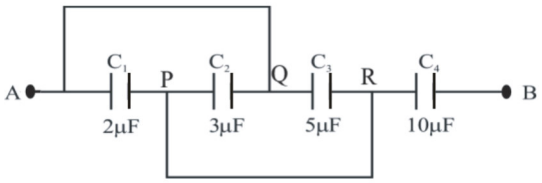
197. (a) A parallel plate capacitor with air between the plates has a capacitance of 8pF (1pF = 10^{-12}F). What will be the capacitance of the distance between the plates is reduced by half, and the space between them is filled with a substance of dielectric constant 6 ?

Or

(b) A 600 pF capacitor is charged by a 200 V supply. It is then disconnected from the supply and is connected to another uncharged 600pF capacitor. How much electrostatic energy is lost in the process?

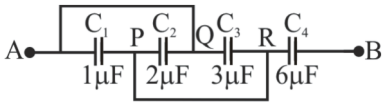
Nagaland Board-2020

198. Calculate the equivalent capacitance between the points A and B in the following Figure:



Haryana Board-2018

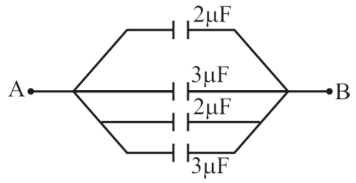
199. Calculate the equivalent capacitance between the points A and B in the following Figure :



Haryana Board-2018

Search On TG: @apna_pdf

200. Calculate the net capacitance between A and B in the given circuit.

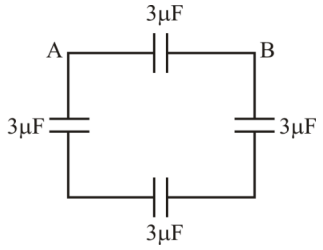


Haryana Board-2016

201. The dimensions of capacitance are …. .

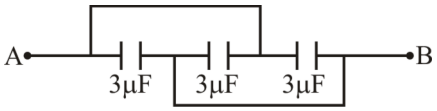
Haryana Board-2016

202. Find out equivalent capacitance between the points A and B in the following circuit :



Chhattisgarh Board-2023

203. Find out equivalent capacitance between the points A and B in the following circuit :



Chhattisgarh Board-2020

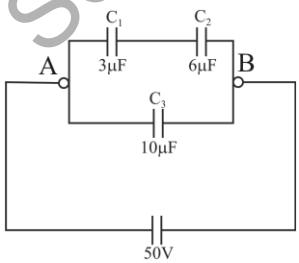
204. +3 μC charge is given to a spherical conductor of radius 18 cm. Calculate capacitance of the conductors. Given $\frac{1}{4\pi\varepsilon_0} = 9\times10^9\ \mathrm{Nm^2C^{-2}}$

Chhattisgarh Board-2019

205. A parallel plate air capacitor has a capacitance of 5μF. It become 50 μF when a dielectric medium occupies the entire space between its two plates. What is the dielectric constant of the medium ?

ISC-2014

206. Three capacitors C_1 = 3μF, C_2 = 6μF and C_3 = 10μF are connected to a 50 V battery as shown in the figure below.



Calculate

(i) the equivalent capacitance of the circuit between points A and B.

(ii) the charge on C_1.

ISC-2017

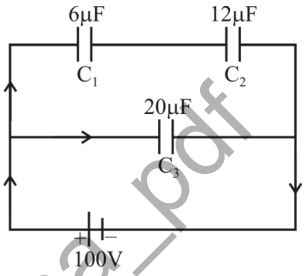
207. Obtain an expression for equivalent capacitance C when three capacitors having capacitance C_1, C_2 and C_3 are connected in series.

ISC-2016, 2012

208. You are provided with 8μF capacitors. Show with the help of a diagram how you will arrange minimum number of them to get a resultant capacitance of 20μF.

ISC-2014

209. Three capacitors C_1 = 6 μF, C_2 = 12μF and C_3 = 20μF are connected to a 100 V battery as shown in figure below.



Calculate

(i) charge on each plate of capacitor C_1.

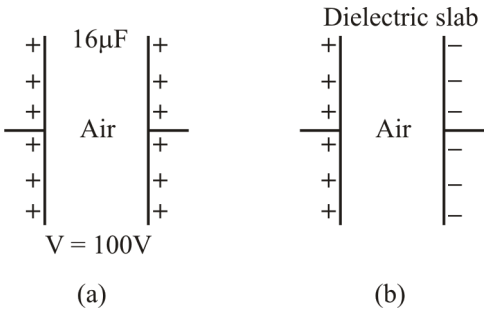
(ii) electrostatic potential energy stored in capacitor C_3.

ISC-2013

210. Three capacitors each of capacitance C are connected in series. Their equivalent capacitance is C_s. The same three capacitors are now connected in parallel. Their equivalent capacitance becomes C_p. Find the ratio (C_p/C_s).

ISC-2011

211. An isolated 16μF parallel plate air capacitor has a potential difference of 1000V [shown in figure (a)]. A dielectric slab having relative permittivity (i.e., dielectric constant) = 5 is introduced to fill the space between the two plates completely [shown in figure (b)]. Calculate



(i) the new capacitance of the capacitor.

(ii) the new potential difference between the two plates of the capacitor.

ISC-2010

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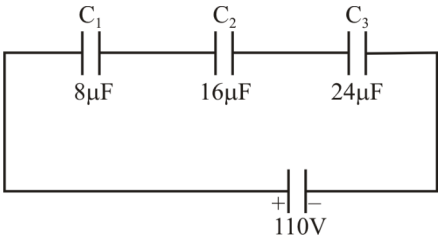
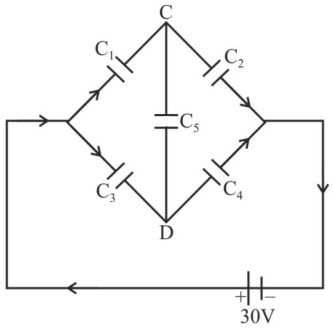
212. Find the electric charge Q_1 on plates of capacitor C_1, shown in figure below.



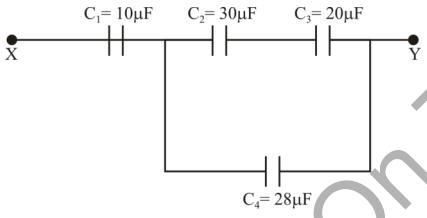
ISC-2009

213. Find the equivalent capacitance of the following circuit between the junctions A and B given $C_1 = C_2 = C_3 = C_4 = 10\mu F$ and $C_5 = 5\mu F$.



ISC-2008

214. Four capacitors C_1, C_2, C_3 and C_4 are connected as shown in figure below. Calculate the equivalent capacitance of the circuit between points X and Y.



ISC-2007

215. Three equal capacitors of capacitance 3μF each are combined to give an equivalent capacitance of 9 μF. Draw a circuit diagram to represent the combination.

Meghalaya Board-2013

210. A capacitor has been charged by a D.C source. What are the magnitudes of conduction and displacement currents, when it is fully charged?

Meghalaya Board-2023

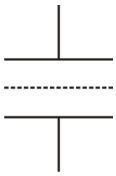
216. Define capacitance of a capacitor and its SI unit.

Maharashtra Board-2019

217. Capacity of a parallel capacitor with dielectric constant 5 is 40 μF. Calculate the capacity of the same capacitor when dielectric material is removed.

Maharashtra Board-2020

218. Figure shows a sheet of aluminium foil of negligible thickness placed between the plates of a capacitor. How will its capacitance be affected, if

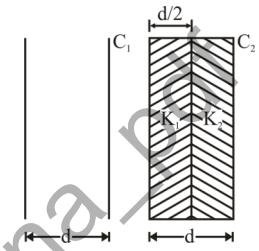


(i) the foil is electrically insulated?

(ii) the foil is connected to the upper plate with a conducting wire?

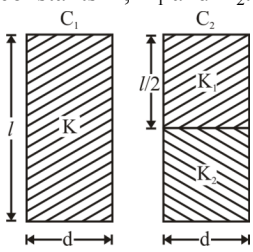
CBSE Foreign-2011

219. You are given an air filled parallel plate capacitor C_1. The space between its plates is now filled with slabs of dielectric constants K_1 and K_2 as shown in figure. Find the capacitance of the capacitor C_2 if area of the plates is A and distance between the plates is d.



CBSE Foreign-2011

220. Two identical parallel plate (air) capacitors C_1 and C_2 have capacitance C each. The space between their plates is now filled with dielectrics as shown in the figure. If the two capacitors still have equal capacitance, then obtain the relation between dielectric constants K, K_1 and K_2.

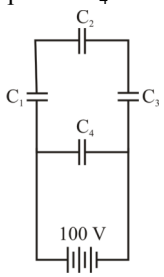


CBSE Foreign-2011

221. What is the area of the plates of 2F parallel plate capacitor having separation between the plates is 0.5 cm?

CBSE All India-2011

222. A network of four capacitors, each of capacitance 15μF, is connected across a battery of 100V, as shown in the figure. Find the (i) net capacitance and (ii) the charge on the capacitor C_4.



CBSE All India-2012

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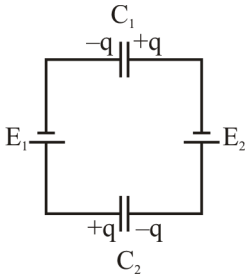
223. A parallel plate capacitor, each of plate area A and separation d between the two plates, is charged with charges +Q and –Q on the two plates. Deduce the expression for the energy stored in capacitor.

CBSE Foreign-2013

224. Determine the potential difference across the plates of the capacitor C_1 of the network shown in the figure. (assume, $E_2>E_1$)

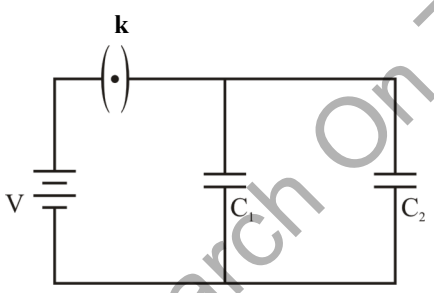


CBSE All India-2013

225. Two parallel plate capacitors of capacitances C_1 and C_2 such that $C_1 = C_2/2$ are connected across a battery of V volts as shown in the figure. Initially, the key (k) is kept closed to fully charge the capacitors. The key is now thrown open a dielectric slab of dielectric constant K is inserted in the two capacitors to completely fill the gap between the plates. Find the ratio of

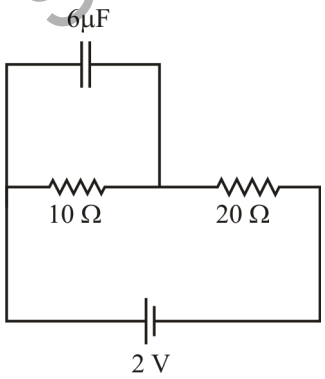
(i) the net capacitance and

(ii) the energies stored in the combination before and after the introduction of the dielectric slab.



CBSE Delhi-2014C

226. Find the charge on the capacitor as shown in the circuit.

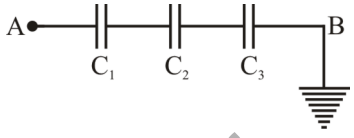


CBSE Foreign-2014

227. A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.

CBSE All India-2014

228. Calculate the potential difference and the energy stored in the capacitor C_2 in the circuit shown in the figure. Given potential at A is 90V, C_1 = 20μ F, C_2 = 30μ F and C_3 = 15μF.

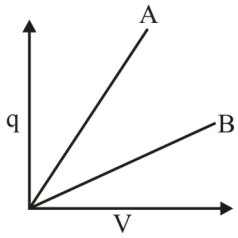


CBSE All India-2015

229. A 100μF parallel plate capacitor having plate separation of 4mm is charged by 200V DC. The source is now disconnected. When the distance between the plates is doubled and a dielectric slab of thickness 4 mm and dielectric constant 5 in introduced between the plates, how will (i) its capacitance, (ii) the electric field between the plates and (iii) energy density of the capacitor get affected? Justify your answer in each case.

CBSE-2019

230. The given graph shows the variation of charge q versus potential difference V for two capacitors C_1 and C_2. Both the capacitors have same plate separation but plate area of C_2 is greater than that C_1. Which line (A or B) corresponds to C_1 and why?



CBSE All India-2014C

231. Why does current in steady state not flow in a capacitor connected across a battery? However, momentary current does flow during charging or discharging of the capacitor.

Explain.

CBSE All India-2017

232. The distance between the two plates of a capacitor is doubled and the area of each plate is halved. What happens to the capacitance?

Odisha Board-2020

233. What is the expression for the capacitance of a parallel-plate capacitor with air as the dielectric?

Odisha Board-2023

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234. What happens to the capacitance of a capacitor when a dielectric slab is placed between its plates?

Manipur Board-2022

235. Derive the formula for equivalent capacitance when the capacitors are connected in series.

Telangana Board-2015

236. A parallel plate capacitor with air between the plates has a capacitance C. What will be the capacitance if (a) the distance between the plates of doubled? (b) the space between the plates is filled with a substance of dielectric constant 5?

Karnataka Board-March, 2020

237. On what factors does the capacitance of a parallel plate capacitor depends?

Karnataka Board-March, 2017

238. What is a capacitor?

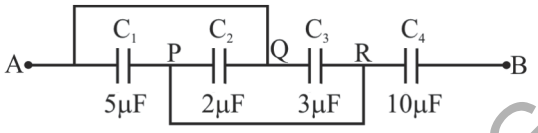
Karnataka Board-July, 2014

239. Derive an expression for energy stored in a parallel plate capacitor.

Uttarakhand Board-2019

Section-C (Short Answer)

240. Calculate the equivalent capacitance between the points A and B in the following Figure:



Haryana Board-2018

241. Derive an expression for the capacitance of a parallel plate capacitor with a dielectric medium between the plates. write. Write the applications of capacitors.

Meghalaya Board-2021
Chhattisgarh Board-2021
Uttarakhand Board-2020
UP Board-2020
Tamil Nadu Board-2016
MP Board-2015

242. Derive the expression for equivalent capacitance, when capacitors are connected in parallel.

Tamil Nadu Board-2023

243. Write expression for capacitance of a parallel plate capacitor and explain the effect of dielectrics on capacitance.

Haryana Board-2017

244. Write expression for capacitance of three capacitors in series and parallel combinations.

Haryana Board-2017

245. Obtain the formula for the capacitance of a parallel plate capacitor.

Gujarat Board- May, 2021

246. A capacitor consists of three parallel plates of equal area A. The distance between them is d_1 and d_2. Dielectric material having permittivity ε_1 and ε_2 is present between the plates.

(a) Calculate the capacitance of such a system.
(b) Express this capacitance is terms of K_1 and K_2

Gujarat Board- March, 2019

247. Drive expression for the capacity of a parallel plate condenser. How can its capacity be increased?

MP Board-2018

248. Explain series combination and parallel combination of condensers with circuit diagram and obtain expressions for equivalent capacities of both type of combinations.

MP Board-2019

249. Obtain expression for the capacity of parallel plate condenser. On what factors it depends ?

MP Board-2020

250. Derive the expression for the capacitance of spherical capacitor. How its capacitance can be increased?

Chhattisgarh Board-2018
MP Board-2014

251. A parallel plate capacitor has plate separation "d" and the area of each plate is "A". The space between the plates is completely filled with a dielectric of constant K. Derive the expression for the capacity of the parallel plate capacitor.

Assam Board-2016

252 **(a)** Draw a figure of a parallel combination of three capacitors of capacitances C_1, C_2 and C_3.
(b) Derive an expression for the effective capacitance of this combination.

Kerala Board-2021

253. Write any one difference between polar and non-polar molecule. Give one example each for polar and non-polar molecule.

Kerala Board-2021

254. The work function of caesium metal is 2.14 eV. When light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. ($h = 6.6 \times 10^{-34}$ js)

(a) Define work function.
(b) Calculate the maximum kinetic energy of the emitted electrons.
(c) Calculate the stopping potential.

Kerala Board-2020

255. Two capacitors of capacities C_1 and C_2 are connected in series and then in parallel. Obtain expressions for effective capacities in two cases.

Kerala Board-2017

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256. Why does a capacitor block d.c. whereas an inductor allows d.c. to pass through it easily?

Meghalaya Board-2015

257. A parallel plate capacitor is made of two foils, each of surface area 2 m^2, separated by paper 7×10^{-5} m thick. What is its capacitance ? [K = 3.5 for paper]

Meghalaya Board-2014

258. A parallel plate capacitor filled with air has an area of 6 cm^2 and plate separation of a 3 mm. Calculate its capacitance.

Maharashtra Board-2022

259. **(a)** With the help of a diagram, obtain an expression for the effective capacitance of three capacitors connected in parallel. A voltage 'V' is applied across the combination.

Also, write the general expression for effective capacitance of n capacitors connected in parallel.

(b) What will be the effect on the voltage across each capacitor if one capacitor is removed from the above combination in case (a) ?

Goa Board-2023

260. **(i)** How is the electric field due to a charged parallel plate capacitor affected when a dielectric slab is inserted between the plates fully occupying the intervening region?

(ii) a slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor but has thickness $\frac{1}{2}\mathbf{d}$, where d is the separation between the plates. Find the expression for the capacitance when the slab is inserted between the plates

CBSE Foreign-2010

261. A parallel plate capacitor, each with plate area A and separation d is charged to a potential difference V. The battery used to charge it remains connected. A dielectric slab of thickness d and dielectric constant K is now placed between the plates. What change if any will take place in

(a) charge on plates?

(b) electric field intensity between the plates?

(c) capacitance of the capacitor?

Justify your answer in each case.

CBSE Delhi-2010

262. A parallel plate capacitor is charged by a battery. After sometime, the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted between the plates. How will

(i) the capacitances of the capacitor,

(ii) potential difference between the plates and

(iii) the energy stored in the capacitors be affected? Justify your answer in each case.

CBSE Delhi-2010

263. How would charge on the plates be affected if a 3 mm thick mica sheet of K = 6 is inserted between the plates while the voltage supply remains connected?

CBSE Foreign-2014

264. The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop.

CBSE Delhi-2014

265. Two capacitores of unknown capacitances C_1 and C_2 are connected first in series and then in parallel across a battery of 100V. If the energy stored in the two combinations is 0.045J and 0.25J respectively, then determine the value of C_1 and C_2. Also, calculate the charge on each capacitor in parallel combination.

CBSE All India-2015

266. A 12pF capacitor is connected to a 50 V battery. How much electrostatic energy is stored in the capacitor? If another capacitor of 6 pF connected in series with it with the same battery connected across the combination, find the charge stored and potential difference across each capacitor.

CBSE Delhi-2017

267. A 200 μF parallel plate capacitor having plate separation of 5 mm is charged by a 100 V DC source. It remains connected to the source. Using an insulated handle, the distance between the plates is doubled and a dielectric slab of thickness 5 mm and dielectric constant 10 is introduced between the plates. Explain with reason, who the (i) capacitance, (ii) electric field between the plates and (iii) energy density of the capacitor will changes.

CBSE-2019

268. Obtain an expression for effective capacitance of two capacitors connected in series.

Karnataka Board-July, 2019

269. What is capacitor? A parallel plate capacitor is charged from a battery. After disconnecting the battery from the capacitor the distance between the plates is doubled. What will be its effect on following-

(i) On capacitance

(ii) On stored energy

Uttarakhand Board-2023

Section-D (Long Answer)

270. What is a capacitor ? Explain its principle. Obtain a relation for the capacitance of a parallel plate capacitor.

J&K Board-2017, 2014

271. Derive an expression for electric potential at a point due to an electric dipole. Also discuss the special cases.

J&K Board-2023

Search On TG: @apna_pdf

272. Define capacitance of a capacitor. Give its S.l. unit.

J&K Board-2023

273. Define electrical capacity. Prove that when we connect two charged conductors by a conducting wire of negligible capacity the ratio of change in their potential is inversely proportional to ratio of their capacities. Draw necessary diagram.

Rajasthan Board-2011

274. Define capacitance of a capacitor. Obtain an expression for the capacitance of a parallel plate capacitor and hence explain the effect of a dielectric on its capacitance.

Nagaland Board-2017

275. An electrical technician requires a capacitance of 2μf in a circuit across a potential difference of 1 KV. A large number of 1μf capacitors are available to him each of which can with stand a potential difference of not more than 400V. Suggest a possible arrangement that requires the minimum number of capacitors.

Gujarat Board- August, 2020

276. Draw labelled diagrams and derive expressions for the resultant capacity when capacitors are connected in :

(i) Series Combination

(ii) Parallel Combination

MP Board-2012

277. The distance between the two plates of a parallel plate capacitor is d.A dielectric slab of thickness t is introduced between them, then obtain the expression for capacity if t < d.

What would be the effect in capacity if metal is used as dielectric medium?

Chhattisgarh Board-2023

278. What is capacitor? Derive an expression for the capacity of parallel plate capacitor write down one application of capacitor.

Chhattisgarh Board-2022

MP Board-2022

279. What is the potential energy of a capacitor? Derive its expression. Where and in which form this energy is found?

Chhattisgarh Board-2020

280. Derive the expression for capacitance of a parallel plate capacitor when a partial dielectric medium plate of thickness t is placed in between its plates. What will be the value of capacitance if t = 0?

Chhattisgarh Board-2019

(OR)

Derive the formula for the capacitance of a parallel plate capacitor partially filled with a dielectric.

UP Board-2023

281. A parallel plate capacitor, with air between its plates and having capacitance C is fully charged by a battery of emf V volt. Then the battery is disconnected. Now the separation between the plates of the parallel plate capacitor is doubled. In what way will the following physical quantities be affected?

(i) Capacitance, (ii) Charge, (iii) Potential difference between the plates, (iv) Strength of electrostatic field between the plates, and (v) the electrostatic potential energy stored in the capacitor per unit volume. State reason for your answer in each case.

NIOS-2016

282. **(a)** How does a capacitor acquire energy on charging? Obtain an expression for this energy.

(b) A parallel plate capacitor of capacitance 20 pF is charged to a potential difference 10 V between its plates. The charging battery is then removed and a dielectric slab of K = 5 is slipped between its two plates. What is potential energy of the device, both before and after the slab is introduced. What is the reason for the difference in energy in the two cases?

NIOS-2016

283. Why is an insulator sometimes called a dielectric? What is the main difference between free and bound charge? Generally one of the two plates of a Capacitor System is earthed, why? Derive the expression for the energy stored in a charged capacitor.

Assam Board-2017

284. Three capacitors of capacitances 2 pF, 3 pF and 4 pF are connected in parallel.

(a) Write the SI unit of capacitance.

(b) Calculate the effective capacitance of the combination.

(c) Determine the charge on each capacitor if the combination is connected to a 100 V supply.

Kerala Board-2020

285. Capacitor is an arrangement to increase the charge carrying capacity of a conductor.

(a) Each plate of a parallel plate capacitor has a charge q on it. The capacitor is now connected to a battery. Pick out the correct statement/ statements:

(i) The facing surfaces of the plates have equal and opposite charges.

(ii) The battery supplies equal and opposite charges to the two plates.

(iii) The two plates of the capacitor have equal and opposite charges.

(b) The plates of a parallel plate capacitor each of area A is charged with charges + Q and – Q. Deduce the forces acting between the plates of the capacitor.

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(c) Van De Graaff generator is a high voltage generator used to accelerate charged particles.
Draw a labeled schematic diagram of a Van De Graaff generator and state the principle behind its working.

Kerala Board-2013

286. What is Parallel Plate Capacitor? Obtain an expression for the capacitance of a parallel plate capacitor when a conducting slab is inserted between its plates.

J&K Board-2011

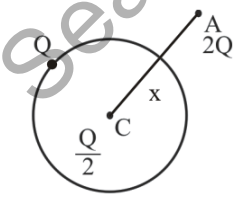
287. What is parallel plate capacitor ? Derive an expression for the energy stored in a capacitor.

J&K Board-2020

288. **(i)** A parallel plate capacitor is charged by a battery to a potential. The battery is disconnected and a dielectric slab is inserted to completely fill the space between the plates.
How will
(a) its capacitance
(b) electric field between the plates and
(c) energy stored in the capacitor be affected? Justify your answer giving necessary mathematical expressions for each case.
(ii) **(a)** Draw the electric field lines due to a conducting sphere.
(b) Draw the electric field lines due to a dipole.

CBSE All India-2011

289. **(i)** Explain using suitable diagrams, the difference in the behaviour of a
(a) conductor and
(b) dielectric in the presence of external electric field. Define the terms polarisation of a dielectric and write its relation with susceptibility.
(ii) A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge Q/2 is placed at its centre C and another charge +2Q is placed outside the shell at a distance x from the centre as shown in the figure.



Find
(a) the force on the charge at the centre of shell and at the point A,
(b) the electric flux through the shell.

CBSE All India-2015

290. **(i)** If two similar large plates, each of area A having surface charge densities + σ and –σ are separated by a distance d in air, find the expression for
(a) field at points between the two plates and on outer side of the plates. Specify the direction of the field in each case.
(b) two potential difference between the plates.
(c) the capacitance of the capacitor so formed.

(ii) Two metallic spheres of radii R and 2R are charged, so that both of these have same surface charge density σ. If they are connected to each other with a conducting wire, in which direction will the charge flow and why?

CBSE All India-2016

291. The plates of a parallel plate capacitor have area of 100 cm^2 each and are separated by 3 mm. The capacitor is charged by connecting it to a 400 V supply.
(a) Calculate the electrostatic energy stored in the capacitor.
(b) If a dielectric of dielectric constant 2.5 is introduced between the plates of the capacitor, then find the electrostatic energy stored and also change in the energy stored.

Karnataka Board-July, 2018

292. In a parallel plate capacitor with air between the plates, each plate has an area of 3×10^{-3} m^2 and the distance between the plates is 3 mm. Calculate the capacity of the capacitor. if this capacitor is connected to a 100V supply. What is the charge on each plate of the capacitor? $\left(\mathbf{E_0 = 8.854 \times 10^{-12}\,Fm^{-1}}\right)$

Karnataka Board-July, 2020

293. In a parallel plate capacitor with air between the plates, each plate has an area of 6×10^{-3} m^2 and the distance between the plates is 3 mm. Calculate the capacitance of the capacitor.
If this capacitors is connected to a 100V supply. What is the charge on the each plate of the capacitor?

Karnataka Board-March, 2014

294. What do you understand by capacity of any conductor ? Find an expression for the capacity of a cylindrical condenser.

Bihar Board-2023

V. Combination of Capacitors

Section-A (Multiple Choice Questions)

295. **6 identical capacitor are joined in parallel and are charged with a battery of 10V. Now the battery is removed and they are joined in series with each other. In this condition what would be the potential difference between the free plates in the combination?**

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(a) 60V (b) 30V

(c) 10V (d) $\frac{10}{6}$V

Gujarat Board- May, 2021

Ans. (a) :

296. Three capacitors of 2pF, 3pF and 4pF are connected in parallel. What is the total capacitance of a network?

(a) $\frac{12}{13}$pF (b) 9pF

(c) $\frac{13}{12}$pF (d) $\frac{1}{9}$pF

Gujarat Board- March, 2020

Ans. (b) :

297. Two capacitors when connected in series, their equivalent capacitance is 3μF and when they are connected in parallel their equivalent capacitance is 16μF. Their values are respectively _____ μF and _____μF.

(a) 8,8 (b) 8,16

(c) 16,1 (d) 4,12

Gujarat Board-March, 2022

Ans. (d) :

298. When n capacitors, each of equal value C, are connected in series, the equivalent capacitance of the combination = _____.

(a) n^2C (b) $\frac{C}{n^2}$

(c) $\frac{C}{n}$ (d) nC

Gujarat Board- July, 2022

Ans. (c) :

299. The expression for the effective capacitance C of two capacitors of capacitance C_1 and C_2 combined in series is-

(a) $C = C_1 + C_2$

(b) $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$

(c) $C = C_1 \times C_2$

(d) $\frac{1}{C} = \frac{1}{C_1} \times \frac{1}{C_2}$

Uttarakhand Board-2022

Ans. (b) :

300. Three capacitors of capacitance 6μF each are available. The maximum and minimum capacities which may be obtained by them are

(a) 3μF, 12μF (b) 2μF, 12μF

(c) 2μF, 18μF (d) 6μF, 18μF

Bihar Board-2023, 2022

Ans. (c) :

Section-B (Very Short Answer)

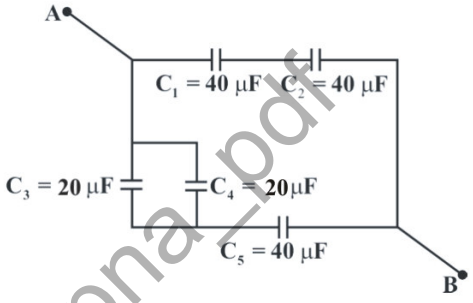
301. Three capacitors, each of capacitance 3pF are connected in series. what is the total capacitance of the combination?

Tamil Nadu Board-2016

302. Three capacitors of capacitance 1μF, 2μF and 3μF are connected in series. Find the total capacitance of combination.

J&K Board-2022

303. If C_1, C_2, C_3, C_4, C_5 five capacitors are connected in an electrical circuit as shown in figure, then calculate the equivalent capacitance of this mesh (network) between point A and point B.



Rajasthan Board-2022

304. Derive an expression for capacitance of the parallel plate capacitor.

Gujarat Board-March, 2022

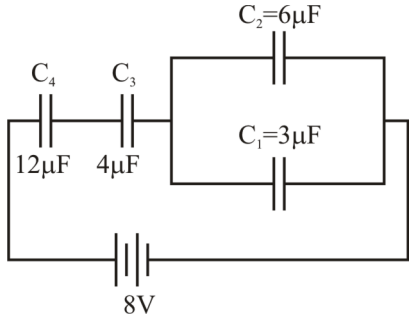
305. Three capacitors, whose capacitances are 2 pF, 3pF and 4pF respectively, are connected in series order, then find the equivalent capacitance of the combination.

Chhattisgarh Board-2021

306. Obtain an expression for equivalent capacitance of two capacitors C_1 and C_2 connected in series.

Maharashtra Board-2023

307. In a network, four capacitors C_1, C_2, C_3 and C_4 are connected as shown in the figure.



(a) Find the net capacitance of the circuit.

(b) If the charge on the capacitor C_1 is 6μC, (i) calculate the charge on the capacitors C_3 and C_4 and (ii) net energy stored in the capacitors C_3 and C_4 connected in series.

CBSE-2019

Search On TG: @apna_pdf

308. Three capacitors of capacitance 9pF each are connected in series. The combination is connected to a 120 V supply. Calculate the total capacitance of the combination and the charge on each capacitor.

Uttarakhand Board-2023

309. Explain parallel combination of capacitors. Derive the formula for equivalent capacitance in parallel combination of capacitors.

AP Board-2021

310. The equivalent capacitance of three equal capacitors connected in series combination is **6μF** . If these capacitors are connected in parallel, find out equivalent capacity of the combination.

Bihar Board-2019

Section-C (Short Answer)

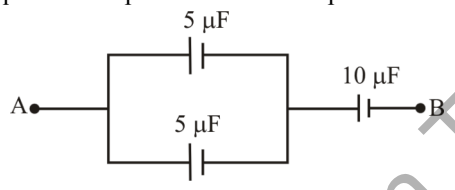
311. Three capacitors each of capacitance 9pF are connected in series.

(a) What is the total capacitance of the combination?

(b) What is the potential difference across each capacitor. If the combination is connected to 120 V supply?

Tamil Nadu Board-2011

312. What is capacitance of a capacitor? Calculate equivalent capacitance between points A and B.



Haryana Board-2017

313. Obtain an expression for the equivalent capacitance of the capacitors connected in series combination.

MP Board-2021

314. You are given two capacitors having capacitances C_1 and C_2.

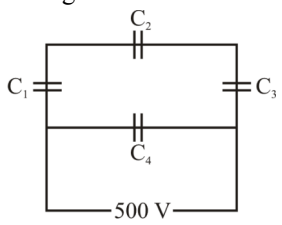
Derive an expression for the equivalent capacitance in

(i) Series and

(ii) Parallel combinations

Kerala Board-2016

315. A network of four capacitor each of 12μF capacitance, if connected to a 500V supply as shows in the figure.



Determine

(i) the equivalent capacitance of the network and

(ii) the charge on each capacitor.

CBSE All India-2010

316. Three capacitors, each of capacitance 0.3 μF, are connected in parallel. This combination is connected with another capacitor of capacitance 0.1μF in series. What is the resultant capacitance?

Odisha Board-2020

Section-D (Long Answer)

317. Derive expressions for equivalent capacitance of

a) Series and

b) Parallel connections of capacitors.

Gujarat Board- July, 2022

Kerala Board-2017

318. Show that the effective capacitances C of a series combination of three capacitors C_1, C_2 and C_3 is given by

$$C = \frac{C_1C_2C_3}{C_1C_2 + C_2C_3 + C_3C_1}$$

CBSE All India-2010C

VI. Energy Stored in Capacitor

Section-A (Multiple Choice Questions)

319. The capacitance of a variable capacitor joined with a battery of 100 V is changed from 2μF to 10μF, What is the change in the energy stored in it ?

(a) 6.5×10^{-2}J (b) 2.5×10^{-2}J

(c) 2×10^{-2}J (d) 4×10^{-2}J

Gujarat Board- May, 2021

Ans. (d) :

320. Energy of a charged capacitor is U. Now it is removed from a battery and then connected to two other identical uncharged capacitors in parallel. What will be the energy of each capacitor?

(a) $\frac{U}{4}$ (b) $\frac{3U}{2}$

(c) U (d) $\frac{U}{9}$

Gujarat Board-2023

Gujarat Board- March, 2019

Ans. (a) :

321. A 700 pF capacitor is charged by a 50 V battery. How much electrostatic energy is stored by it?

(a) 6.7×10^{-7} J (b) 8.75×10^{-7} J

(c) 13.6×10^{-9} J (d) 17.0×10^{-8} J

Meghalaya Board-2018

Ans. (b) :

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322. A 900 pF capacitor is charged by a 100 V battery. The electrostatic energy stored by the capacitor is

(a) 9×10^5 J (b) 4.5×10^{-6} J
(c) 2.2×10^{-6} J (d) 9×10^{-10} J

Meghalaya Board-2015

Ans. (b) :

323. A capacitor of capacitance C_1 is charged upto a potential V and then connected in parallel to an uncharged capacitor of capacitance C_2. The final potential differnce across each capacitor would be

(a) $\frac{C_2 v}{C_1 + C_2}$

(b) $\frac{C_1 v}{C_1 + C_2}$

(c) $\left(1 + \frac{C_2}{C_1}\right) v$

(d) $\left(1 - \frac{C_2}{C_1}\right) v$

Goa Board-2019

Ans. (b) :

324. n identical bulbs, each designed to draw a power P from a supply, are joined in series across the same supply. the total power which they draw is

(a) $\frac{P}{n}$ (b) $\frac{p}{n^2}$
(c) np (d) P

Goa Board-2018

Ans. (a) :

325. The stored energy of a capacitor charged to 100 V. is 1 J. Capacitance of the capacitor is:

(a) 2×10^4 F (b) 2×10^{-4} F
(c) 2×10^2 F (d) 2×10^{-2} F

Bihar Board-2019

Ans. (b) :

Section-B (Very Short Answer)

326. Calculate the increase in energy of a capacitor of capacity 6 μF when its potential difference is increase from 10 volt to 20 volt.

Rajasthan Board-2011

327. A capacitor is charged through a batter. Whether energy stored by the capacitor is equal to energy supplied by the battery? Answer with reason.

UP Board-2021

328. A 400 pF capacitor is charged by a 100V Battery. How much electrostatic energy stored by the capacitor?

Assam Board-2013

329. Show that the energy stored in a charged capacitor is $E = \frac{1}{2}CV^2$, where the symbols have their usual meaning.

Assam Board-2023
J&K Board-2023

(OR)

Obtain the expression for energy stored in a capacitor 'C' when it is connected to an electric supply of 'V' volts.

NIOS-2018

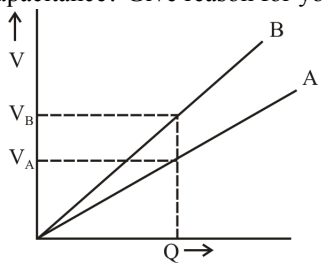
(OR)

Derive the expression for energy stored in a charged capacitor.

Karnataka Board-March, 2020, 2017, 2016
Meghalaya Board-2019
Haryana Board-2016
J&K Board-2015
CBSE All India-2010C

330. **(a)** Obtain the expression for the energy stored in a charged parallel-plate capacitor.

(b) The graph shows the variation of voltage V across the plates of two capacitors A and B versus increase of charge Q stored on them. Which of the two capacitors has higher capacitance? Give reason for your answer.



Meghalaya Board-2021

331. Net capacitance of three identical capacitors in series is 1μF. What will be their net capacitance, if connected in parallel?

Find the ratio of energy stored in these two configurations, if they are both connected to the same source.

CBSE All India-2011

332. Deduce the expression for the electrostatic energy stored in a capacitor of capacitance C and having charge Q.

How will the

(i) energy stored and

(ii) the electric field inside the capacitor be affected when it is completely filled with a dielectric material of dielectric constant K?

CBSE All India-2012

333. A capacitor of capacitance 2μF charged to a potential difference of 50. What is the energy stored in it?

Odisha Board-2022

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Section-C (Short Answer)

334. Derive an expression for the energy stored in a capacitor. In what form is the energy stored in a charged capacitor?

Punjab Board-2018

335. Derive an expression for energy stored in a capacitor.

J&K Board-2018

336. Derive an expression for energy stored in a charged capacitor.

J&K Board-2012

337. A 600 pF capacitor is charged by a 200V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. How much electrostatic energy is lost in the process ? **3**

Gujarat Board- March, 2020

338. A 100 pF capacitor is charged by a potential difference of 100V. What is the amount of charge stored? What is the electrostatic energy stored in the capacitor?

Assam Board-2015

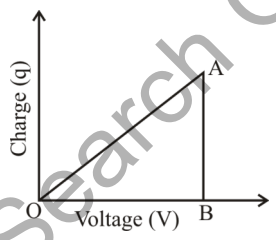
339. A capacitor is a device which can store electrostatic energy within the electric field set up between the plates.

(a) Write an expression for the energy stored in a capacitor in terms of charge Q and capacity C.

(b) The electric lines of force never intersect one another Explain this statement.

Kerala Board-2017

340. The variation of charge (q) on a capacitor with voltage (V) is shown in the figure given below:



The area of the ΔOAB represents

(i) Capacitance

(ii) Capacitive reactance

(iii) Electric field between the plates

(iv) Energy stored in the capacitor

Kerala Board-2016

341. What is the capacity of a parallel plate capacitor, whose area of plates is 1.13×10^9 m^2 and separation between them is 0.7 cm? Also, find the energy stored in the capacitor for a potential of 200 volt.

J&K Board-2019

342. Find the ratio of the potential differences that must be applied across the parallel and the series combination of two identical capacitors, so that the energy stored in the two cases becomes the same.

CBSE Foreign-2010

343. A parallel plate capacitor is charged to a potential difference V by a DC source. The capacitor is then disconnected from the source. If the distance between the plates is doubled, state with reason, how the following will change?

(i) Electric field between the plates

(ii) Capacitance

(iii) Energy stored in the capacitor.

CBSE Delhi-2010

344. A capacitor of unknown capacitance is connected across a battery of V volt. The charge stored in it is 360μC. When potential across the capacitor is reduced by 120V, the charge stored in it becomes 120 μC.

Calculate

(i) The potential V and the unknown capacitance C.

CBSE Delhi-2013

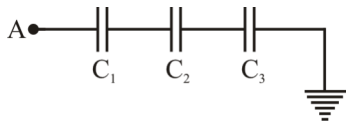
345. What will be the charge stored in the capacitor, if the voltage applied had increased by 120?

CBSE Delhi-2013

346. A capacitor of 200pF is charged by a 300V battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 100pF. Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor.

CBSE Foreign-2012

347. Calculate the potential difference and the energy stored in the capacitor C_2 in the circuit shown in the figure. Given potential at A is 90 V, C_1 = 20μF, C_2 = 30 μF and C_3 = 15μF



CBSE Delhi-2015

348. Find the ratio of the potential differences that must be applied across the parallel and series combination of two capacitors C_1 and C_2 with their capacitances in the ratio 1 : 2, so that the energy stored in these two cases becomes the same.

CBSE All India-2016

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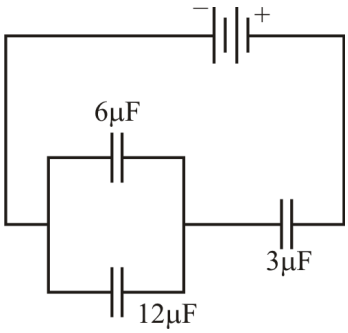
349. In the following arrangement of capacitors, the energy stored in the 6μF capacitor is E.



Find the value of the following

(i) energy stored in 12μF capacitor

(ii) energy stored in 3μF capacitor

(iii) total energy drawn from the battery.

CBSE Foreign-2016

Section-D (Long Answer)

350. What is a capacitor? Explain its principle. Derive and expression for energy stored in a charged capacitor. Where is this energy stored? Draw a labelled diagram of parallel plate capacitor and show the direction of electric field produced in it.

Rajasthan Board-2011

351. The plates of a parallel plate capacitor have an area of 90 cm^2 each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply.

(a) How much electrostatic energy is stored by the capacitor?

(b) View this energy as stored in the electrostatic field between the plates and obtain the energy per unit volume u. Hence arrive at a relation between u and the magnitude of the electric field E between the plates.

Gujarat Board-2023

352. A charged capacitor is connected to an inductor at an instant of time t = 0. If the capacitor and the inductor are taken to be pure, write down the equation of effective potential difference across the combination at any instant of time t and solve it for instantaneous current through the combination. Explain briefly the exchange of electric and magnetic energy between the capacitor and the inductor.

Assam Board-2017

353. **(a)** Derive the expression for the energy stored in parallel plate capacitor.
Hence, obtain the expression for the energy density of the electric field.

(b) A fully charged parallel plate capacitor is connected across an uncharged identical capacitor. Show that the energy stored in the combination is less then the energy stored initially in the single capacitor.

CBSE Delhi-2014

354. A capacitor of capacitance C_1 is charged to a potential V_1 while another capacitor of capacitance C_2 is charged to a potential difference V_2. The capacitors are now disconnected from their respective charging batteries and connected in parallel to each other.

(a) Find the total energy stored in the two capacitors before they are connected.

(b) Find the total energy stored in the parallel combination of the two capacitors.

(c) Explain the reason for the difference of energy in parallel combination in comparison to the total energy before they are connected.

CBSE-2018

355. **(a)** Describe briefly the process of transferring the charge between the two plates of a parallel plate capacitor when connected to a battery. Derive an expression for the energy stored in a capacitor.

(b) A parallel plate capacitor is charged by a battery to a potential difference V. It is disconnected from battery and then connected to another uncharged capacitor of the same capacitance. Calculate the ratio of the energy stored in the combination to the initial energy on the single capacitor.

CBSE Delhi-2019

356. In a circular parallel plate capacitor radius of each plate is 5 cm and they are separated by a distance of 2mm. Calculate the capacitance and the energy stored, when it is charged by connecting the battery of 200 V (given $\epsilon_o = 8.854 \times 10^{-12} Fm^{-1}$).

Karnataka Board-March, 2019

357. When two capacitors are connected in series and connected across 4 kV line, the energy stored in the system is 8J. The same capacitors, if connected in parallel across the same line the energy stored is 36J. Find the individual capacitances.

Karnataka Board-March, 2016

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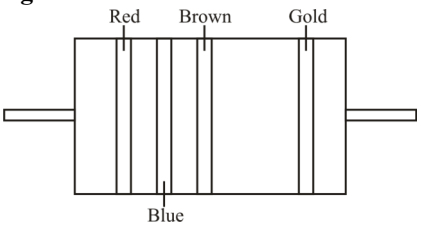
03. Current Electricity

I. Electric Current, Ohm's Law and Limitation of Ohm's Law

Section-A (Multiple Choice Questions)

1. A carbon resistor has coloured bonds as shown in figure below. The resistance of the resistor is



(a) $26\ \Omega \pm 10\%$ (b) $26\ \Omega \pm 5\%$
(c) $260\ \Omega \pm 5\%$ (d) $260\ \Omega \pm 10\%$

ISC-2016

Ans. (c) :

2. The law which relates the potential difference and electric current between two points in a conductor is

(a) Coulomb's law (b) Joule's law
(c) Ampere's law (d) Ohm's law

Odisha Board-2022

Ans. (d) :

3. On connecting two charged objects, electric current does not flow between them if their-

(a) Charges are same
(b) Capacities are same
(c) Potentials are same
(d) Resistances are same

Uttarakhand Board-2023

Ans. (c) :

4. Vector representation of Ohm's law is

(a) $\vec{J} = \sigma\vec{E}$ (b) $\vec{E} = \sigma\vec{J}$
(c) $\vec{J} = \sigma^2\vec{E}$ (d) $\vec{E} = \sigma^2\vec{J}$

Bihar Board-2021

Ans. (a) :

5. The current following in a wire is 1A. If the charge of an electron is 1.6×10^{-19}C, then the number of electrons flowing through the wire per second is

(a) 0.625×10^{13} (b) 6.25×10^{18}
(c) 1.6×10^{-19} (d) 1.6×10^{19}

Bihar Board-2022

Ans. (b) :

6. Two resistors R and 2R are connected in series in an electric circuit. The thermal energy developed in R and 2R will be in ratio

(a) 1 : 2 (b) 1 : 4
(c) 2 : 1 (d) 4 : 1

Bihar Board-2023

Ans. (a) :

7. Vector form of a law can be written as $\vec{J} = \sigma\vec{E}$. The above equation is an equivalent form of a famous law. Name the law.

(a) Biot – Savart's law (b) Ohm's law
(c) Coulomb's law (d) Gauss's law

Kerala Board-2016

Ans. (b) :

8. Ohmic resistance is

(a) Junction diode
(b) Photo-emissive diode
(c) Transistor
(d) Copper wire

MP Board-2022, 2012

Ans. (d) :

9. In current electricity, Ohm's law obeyed by all

(a) solids (b) metals
(c) liquids (d) gases

CBSE-2020
ISC-2011

Ans. (b) :

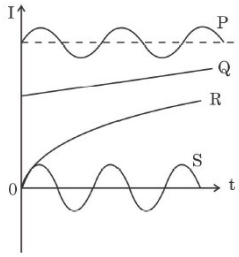
10. A wire of resistance R is cut into n equal parts. These parts are then connected in parallel with each other. The equivalent resistance of the combination is

(a) nR (b) R/n
(c) n/R^2 (d) R/n^2

ISC-2017

Ans. (d) :

11. The figure shows variation of current (I) with time (t) in four devices P, Q, R and S. The device in which an alternating current flows is :



(a) P (b) Q
(c) R (d) S

CBSE-2023

Ans. (d) :

12. A steady current of 8 mA flows through a wire. The number of electrons passing through a cross-section of the wire in 10 s is

Search On TG: @apna_pdf

(a) 4.0×10^{16} (b) 5.0×10^{17}
(c) 1.6×10^{16} (d) 1.0×10^{17}

CBSE-2023

Ans. (b) :

13. The current in a device varies with time t as I = 6 t, where I is in mA and t is in s. The amount of charge that passes through the device during t = 0s to t = 3s is

(a) 10 mC (b) 18 mC
(c) 27 mC (d) 54 mC

CBSE-2023

Ans. (c) :

14. Which of the following is a non-ohmic element?

(a) Diode (b) Corbonresistance
(c) Tungsten wire (d) Copper wire

J&K Board-2015, 2014

Ans. (a) :

15. How much current is flowing through a 5 kΩ resistor when a potential difference of 5V is applied across its ends?

(a) 1 μA (b) 1 mA
(c) 1 A (d) 5 A

Haryana Board-2018

Ans. (b) :

16. How much current is flowing through a 1 kΩ resister when a potential difference of 2V is applied across its end?

(a) 2 μA (b) 2 mA
(c) 2 A (d) 1 A

Haryana Board-2018

Ans. (b) :

17. How much current is flowing through a 20 Ω resistor when a potential difference of 2 V is applied across its ends?

(a) 20 A (b) 2 A
(c) 0.1 A (d) 1.0 A

Haryana Board-2018

Ans. (c) :

18. According to Ohm's law $\left(R = \frac{V}{I}\right)$, as current flowing through a conductor increases, resistance of conductor ——

(a) Increases
(b) Decreases
(c) Remains constant
(d) Nothing can be said

Gujarat Board- March, 2020

Ans. (c) :

19. A steady current flows in a metallic conductor of non-uniform cross-section. Which of the following quantities is constant along the conductor?

(a) Electric field (b) Current density
(c) Current (d) Drift speed

Gujarat Board-March, 2022

Ans. (c) :

20 Two long parallel wires each carrying a current of 1A on the same direction, are placed 1 m apart. The force of attraction between them is :

(a) 2×10^{-7} Nm^{-1} (b) 2×10^{-4} Nm^{-1}
(c) 1×10^{-7} Nm^{-1} (d) 4×10^{-7} Nm^{-1}

Jharkhand Board-2020

Section-B (Very Short Answer)

21. Define electric current. Give its unit.

MP Board-2021
Meghalaya Board-2015

22. Mention two limitations of Ohm's law.

MP Board-2022
Karnataka Board-March-2020, 2015
Karnataka Board-July, 2014

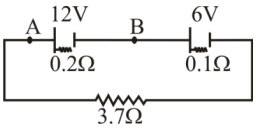
23. State and explain Ohm's law.

Odisha Board-2023
MP Board-2021
Karnataka Board- July, 2018
Karnataka Board-March, 2017
Haryana Board-2017
Tamil Nadu Board-2017, 2016
Meghalaya Board-2015
Assam Board-2014

24. What is current density ? Discuss.

Bihar Board-2023

25. In the Circuit given below, find the potential difference between A and B.



Assam Board-2016

26. **(c)** Inspire of the validity of Ohm's law, it has some limitations. Give one limitation of Ohm's law.

Kerala Board-2014

27. **(c)** Name two devices which do not obey Ohm's law.

Kerala Board-2016

28. What is dark current?

Meghalaya Board-2014

29. Frequency of household electric current is…...

MP Board-2020

30. What is an electric cell? give example.

OR

Write Ohm's law and also draw graph between voltage and current.

MP Board-2023

Search On TG: @apna_pdf

31. Draw the graph between potential difference and current for metallic conductor and bulb of a torch at low potential difference.

UP Board-2022

32. What are meant by ohmic and non-ohmic resistances? Draw graph between voltage and current for non-ohmic circuit and define dynamic resistance.

UP Board-2023

33. State the physical condition in which Ohm's law is not valid for a conductor.

ISC-2002

34. For a metallic conductor, what is the relation between current density (J), conductivity (σ) and electric field intensity (E) ?

ISC-2016

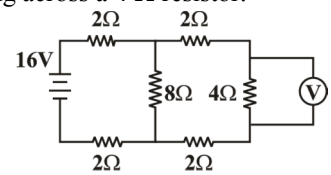
35. Define temperature coefficient of resistance of the material of a conductor.

ISC-2014

36. A current I flows through a metallic wire of radius r and free electrons in it drift with a velocity v_d. Calculate the drift velocity of the free electrons through the wire of the same material, having double the radius, when same current flows through it.

ISC-2014

37. In the circuit given below, find the voltmeter reading across a 4 Ω resistor.



CBSE-2019

38. A copper wire of non-uniform area of cross-section is connected to a d.c. battery. The physical quantity which remains constant along the wire is _____.

CBSE-2020

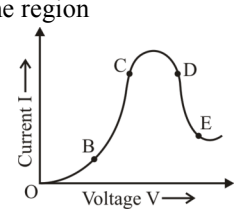
39. The S.I. unit of electric current is …. .

Haryana Board-2016

40. Plot a graph showing variation of current versus voltage for the material GsAs.

CBSE Delhi-2014

41. Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region

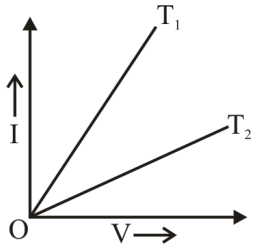


(i) of negative resistance.

(ii) where Ohm's law is obeyed.

CBSE All India-2015

42. I-V graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the figure below. Which of the two temperature is lower and why?



CBSE Delhi-2015

43. When a potential difference is applied across the ends of a conductor, how is the drift velocity of the electrons related to the relaxation time?

CBSE Delhi-2019

44. How does the mobility of electrons in a conductor change, if the potential difference applied across the conductor is doubled, keeping the length and temperature of the conductor constant?

CBSE Delhi-2019

45. If $6{\cdot}25 \times 10^{18}$ electrons flow through a given cross section in unit time, find the current.

Given : charge of an electron is $1{\cdot}6 \times 10^{-19}$ C.

Tamil Nadu Board-2011

Section-C (Short Answer)

46. A wire of 5 ohm is stretched to double its original length. Calculate its new resistance.

J&K Board-2019

47. State Ohm's law. Calculate the conductivity of a conductor of radius 0.5 mm and length 10 cm having resistance 25Ω.

Odisha Board-2020

48. Table given below shows the current (I) voltage (V) relationship of a device.

Voltage (V)	Current (I)
1	20
2	30
3	35
4	50
5	55
6	68

Draw V- I graph. With the help of the graph explain whether the device is showing ohmic or non – ohmic behaviour.

Kerala Board-2016

49. Write any three differences between Resistance and Specific Resistance.

MP Board-2023

Search On TG: @apna_pdf

50. A potential difference 'V' is applied across a load resistor of resistance R. V and R can be varied. If the current that flows in the circuit is I, draw a plot showing the variation of power consumed by the resistor as a function of :

(a) R, keeping V constant
(b) I, keeping R constant
(c) V, keeping R constant

CBSE-2023

51. Derive an expression for force per unit length between two long straight parallel current carrying conductors. Hence, define one ampere.

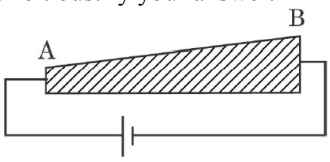
Nagaland Board-2018

Section-D (Long Answer)

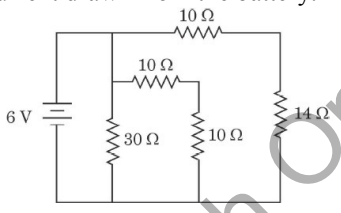
52. Two wires made of same material and of same masses A and B are taken. The diameter of wire A is half to that of B. If the resistance of A be 24 ohm, then calculate the resistance of B.

UP Board-2023

53. **(ii)** A steady current flows through a wire AB, as shown in the figure. What happens to the electric field and the drift velocity along the wire ? Justify your answer.



(iii) Consider the circuit shown in the figure. Find the effective resistance of the circuit and the current drawn from the battery.



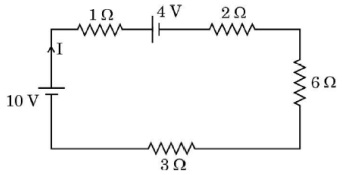
OR

(b)

(i) Define electrical conductivity of a wire. Give its SI unit.

(ii) High current is to be drawn safely from (1) a low-voltage battery, and (2) a high-voltage battery. What can you say about the internal resistance of the two batteries ?

(iii) Calculate the total energy supplied by the batteries to the circuit shown in the figure, in one minute.



CBSE-2023
CBSE Delhi-2014

II. Drift of Electrons, Resistivity, Conductivity and Temperature Dependency of Resistivity

Section-A (Multiple Choice Questions)

54. Specific resistance or resistivity of metals is mostly affected by-

(a) Temperature (b) Pressure
(c) Magnetic field (d) Volume

Uttarakhand Board-2023

Ans. (a) :

55. Yellow colour code of carbon resistance is of value

(a) 3 (b) 4
(c) 5 (d) 8

Bihar Board-2021

Ans. (b) :

56. S.I. unit of resistivity is

(a) ohm (b) ohm.metre
(c) ampere.volt (d) $(ohm)^{-1}$

Bihar Board-2021
MP Board-2015

Ans. (b) :

57. The drift velocity $(\vec{V}_d)$ of free electron inside the conductor placed in an electric field $\vec{E}$ is given as

(a) $\vec{V}_d = -\frac{e\vec{E}}{m}\tau$ (b) $\vec{V}_d = -\frac{e\vec{E}}{m}$
(c) $\vec{V}_d = \frac{e\vec{E}}{m}\tau$ (d) $\vec{V}_d = \frac{e\vec{E}}{m}$

Bihar Board-2022

Ans. (a) :

58. The relation between the drift velocity (V_d) and applied electric field (E) of a conductor is

(a) $V_d \propto E$ (b) $V_d \propto \sqrt{E}$
(c) $V_d \propto E^2$ (d) $V_d \propto \sqrt{E^3}$

Bihar Board-2023

Ans. (a) :

59. What will be the resistance (R) of a wire, when its radius is halved and length is reduced to one-fourth of its original length ?

(a) 4R (b) $\frac{R}{4}$
(c) R (d) 2R

Meghalaya Board-2017

Ans. (c) :

60. S.I. unit of current density is-

(a) Coluomb/meter (b) Ampere/$meter^2$
(c) Coluomb/$meter^2$ (d) Ampere/meter

MP Board-2023

Ans. (b) :

Search On TG: @apna_pdf

61. Two wires of equal length and radii r and 2r are connected in series. Their resistivities are 2ρ and ρ respectively. For the same current passing through the combination, the potential drop across their ends will be in the ratio of :

(a) 2 : 1 (b) 1 : 2
(c) 4 : 1 (d) 8 : 1

CBSE-2023

Ans. (d) :

62. The current density due to drift of electrons in a conductor is given by : (symbols have their usual meanings)

(a) $n e A v_d$ **(b)** $\frac{nAv_d}{e}$

(c) $\frac{nv_d}{eA}$ (d) $n e v_d$

CBSE-2023

Ans. (d) :

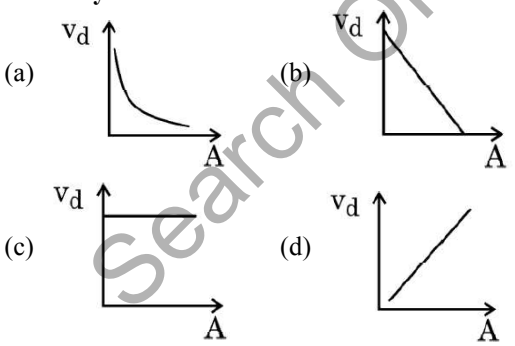
63. Pieces of copper and of silicon are initially at room temperature. Both are heated to temperature T. The conductivity of

(a) both increases.
(b) both decreases.
(c) copper increases and silicon decreases.
(d) copper decreases and silicon increases.

CBSE-2023

Ans. (d) :

64. A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of drift velocity (v_d) of the free electrons as a function of 'A' can be shown by



CBSE-2023

Ans. (d) :

65. The masses of two cylindrical wires of copper are in the ratio of 1 : 3 and their lengths are in the ratio of 5 : 3. The ratio of their resistances will be :

(a) 1 : 3 (b) 2 : 5
(c) 2 : 3 (d) 3 : 5

CBSE-2023

Ans. (d) :

66. Resistivity of a given conductor depends upon

(a) temperature
(b) length of conductor
(c) area of cross-section
(d) shape of the conductor

CBSE-2020

Ans. (a) :

67. In a current carrying conductor, the ratio of the electric field and the current density at a point is called

(a) Resistivity (b) Conductivity
(c) Resistance (d) Mobility

CBSE-2020

Ans. (a) :

68. The conductivity of a metal decreases with the increase in temperature on account of.

(a) decrease in number density of electrons
(b) decrease in resistivity
(c) decrease in relaxation time.
(d) increase in mean free path.

CBSE-2020

Ans. (c) :

69. The potential difference applied across a given conductor is doubled. The mobility of the electrons in the conductor.

(a) is doubled. (b) is halved
(c) remains unchanged. (d) becomes four times.

CBSE-2020

Ans. (b) :

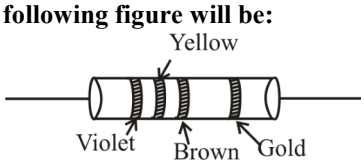
70. The ratio of drift velocity to that of the thermal velocity of an electron in a conductor is of the order of :

(a) 10^{-6} (b) 10^{-8}
(c) 10^{-5} (d) 10^{-10}

J&K Board-2016

Ans. (d) :

71. Tolerance (%) for colour coded resistor in the following figure will be:



(a) 10% (b) 5%
(c) 20% (d) 15%

Rajasthan Board-2023

Ans. (a) :

72. When the distance between two charged particles is halved, the force between them becomes:

(a) one-fourth (b) half
(a) double (b) four times

Haryana Board-2018

Ans. (d) :

Search On TG: @apna_pdf

73. With decrease in temperature, the mobility of a conductor :
(a) increases
(b) decreases
(c) may increases or decrease
(d) does not change

Haryana Board-2018

Ans. (a) :

74. A resistive wire is stretched till its length is increased by 100%. Due to the consequent decrease in diameter, the change in the resistance of a stretched wire will be ———.
(a) 100% (b) 200%
(c) 300% (d) 50%

Gujarat Board- May, 2021

Ans. (c) :

75. A current density of 2.5 Am^{-2} is found to exist in a conductor when an electric field of 5×10^{-8} Vm^{-1} is applied across it. The resistivity of a conductor is ———.
(a) $0.5\times10^{-8}\ \Omega m$ (b) $2\times10^{-8}\ \Omega m$
(c) $1\times10^{-8}\ \Omega m$ (d) $12.5\times10^{-8}\ \Omega m$

Gujarat Board- May, 2021

Ans. (b) :

76. The resistance of the platinum wire of a platinum resistance thermometer at the ice point is 5Ω and at steam point is 5.23Ω. When the thermometer is inserted in a hot bath, the resistance of the platinum wire is 5.46Ω Calculate the temperature of the bath.
(a) 345.65ºC (b) 200ºC
(c) 200K (d) 345.65K

Gujarat Board- August, 2020

Ans. (b) :

77. A steady current flows in a metallic conductor of non uniform cross-section, which of following quantities is constant along the conductor?
(a) electric field (b) current density
(c) current (d) drift speed

Gujarat Board-2023

Ans. (c) :

78. The colour bands of a carbon resistor with three bands having minimum value are ___ in order.
(a) black, brown , silver (b) black, black , silver
(c) black, brown , red (d) black, brown, gold

Gujarat Board-2023

Ans. (c) :

79. Which of the following physical quantity has unit $m^2V^{-1}s^{-1}$?
(a) Mobility (b) Electric field
(c) Drift velocity (d) Resistivity

Gujarat Board-March, 2022

Ans. (a) :

80. The mobility of an electron moving in the electric field E with the drift velocity $\vec{v}_d$, μ = _____.
(a) $\frac{E}{|v_d|}$ (b) $\frac{|v_d|}{E}$
(c) $|v_d|E$ (d) $\frac{1}{2}|v_d|E^2$

Gujarat Board- July, 2022

Ans. (c) :

81. Nichrome wire is used as the heating element because it has :
(a) High specific resistance
(b) Low specific resistance
(c) High conductivity
(d) Low melting point

Tamil Nadu Board-2018

Ans. (a) :

82. The colour code of a carbon resistor is, Brown, Black, Brown and Red. The value of the resistor is :
(a) 10 Ω ± 5% (b) 1 k Ω ± 2%
(c) 100 Ω ± 2% (d) 10 Ω ± 2%

Tamil Nadu Board-2017

Ans. (c) :

Section-B (Very Short Answer)

83. For alloys the value of temperature coefficient of resistance is very high. (True/False)

Punjab Board-2018

84. The force between two parallel current carrying conductor is _____.

Rajasthan Board-2023

85. Do as directed:
(i) The resistance of a conductor depends upon its length and area of cross-section. (True/False)

J&K Board-2018

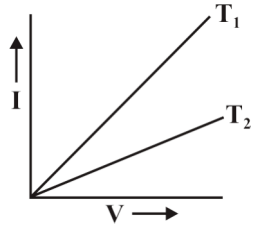
86. How does the resistivity of a conductor vary with temperature?

J&K Board-2011

87. Calculate the resistivity of a wire of length 1m, radius 0.1 mm and resistance 100Ω.

Odisha Board-2022

88. V-I graph for a metallic wire at two different temperatures is shown in the figure. Which of these two temperature is higher and why?



Manipur Board-2022

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89. A carbon resistor has three strips of red colour and a gold strip. What is the value of the resistor?

Manipur Board-2022

90. If a wire is stretched to double its length, what will be its new resistivity?

Manipur Board-2022

91. Why does the resistance of conductor increase with an increase in temperature?

Manipur Board-2022

92. Define electrical resistivity of material of a conductor:

Karnataka Board-March, 2019

93. Define 'drift velocity' of free electrons.

Karnataka Board-July, 2018

94. Define mobility of electron.

Karnataka Board-March, 2014, 2017

95. Represent graphically the variation of resistivity with absolute temperature for copper and nichrome metals.

Karnataka Board-July, 2018

96. Define drift velocity of electrons.

Chhattisgarh Board-2023
Bihar Board-2021
MP Board-2021
CBSE-2020
Meghalaya Board-2019
Karnataka Board-July-2018, 2014
Tamil Nadu Board-2016, 2015
CBSE Delhi-2016, 2014

97. Draw the curve to show the variation of resistivity as a function of temperature for copper.

Karnataka Board-July, 2020

98. Establish a relation between drift velocity of free electrons and electric current.

Uttarakhand Board-2022
MP Board-2017
Haryana Board-2016

99. Compare the amount of heat developed in three similar wires having lengths in the ratio 1:5:8 and radii 1:2:3 when joined in parallel.

Assam Board-2016

100. Using an expression for drift velocity, show that the mobility of free electron is directly proportional to its relaxation time.

Meghalaya Board-2019

101. Calculate the resistivity of the material of a wire 1.0 m long. 0.4 mm in diameter and having a resistance of 2.0 Ω.

Meghalaya Board-2021

102. The potential difference across a given wire is increased. What happens to the drift velocity of the free electrons?

Meghalaya Board-2018

103. The specific resistances of copper, silver and constantan are 1.78×10^{-6} Ω-cm, 1×10^{-6} Ω-cm respectively. Which is the best conductor and why?

Meghalaya Board-2014

104. If length of a conducting wire becomes twice, when stretched. Then how many times, resistance will increase, calculate?

MP Board-2017

105. Establish the relationship between drift velocity and current density.

Haryana Board-2022
MP Board-2021

106. A carbon resistor has colour band Yellow, Green and Red respectively. Write its resistance.

Chhattisgarh Board-2023, 2019

107. A wire of resistivity ρ is stretched to three times its length. What will be the effect on its resistivity?

Chhattisgarh Board-2022

108. The resistance of carbon resistor is 7600 ± 20% ohms. Write the order of colour rings for it.

Chhattisgarh Board-2020

109. Alloys are used to make the standard resistance. Why?

Chhattisgarh Board-2020

110. A metallic wire has a resistance of 3.0Ω at 0°C and 4.8Ω at 15°C. Find the temperature coefficient of resistance of its material.

ISC-2016

111. Draw labelled graphs to show how electrical resistance varies with temperature for
(i) a metallic wire **(ii)** a piece of carbon

ISC-2015

112. When a potential difference of 3V is applied between the two ends of a 60cm long metallic wire, current density in it is found to be 1×10^{-7} Am^{-2}. Find conductivity of the material of the wire in SI system.

ISC-2012

113. What is current density ? Write the vector equation connecting current density J with electric field intensity E, for an ohmic conductor.

ISC-2010

114. Two wires A and B of equal masses and of the same material are taken. The diameter of wire A is half the diameter of wire B. If the resistance of wire A is 24 Ω, calculate the resistance of wire B.

ISC-2006

115. A potential difference of V volt is applied across a copper wire of length *l* and diameter d. How will the drift velocity be affected, if
(i) V is doubled. **(ii)** *l* is doubled.

ISC-2005

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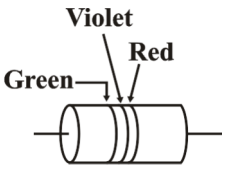
116. Name one material whose resistivity decreases with rise in temperature. Explain briefly on the basis of free electron theory why the resistivity decreases.

ISC-2000

117. Draw a plot of resistivity of copper as a function of temperature.

CBSE-2019

118. A carbon resistor is shown in the figure. Using colour code, write the value of the resistance.



CBSE-2019

119. How is the drift velocity in a conductor affected with the rise in temperature?

CBSE-2019

120. When a potential difference is applied across the ends of a conductor, how is the drift velocity of the electrons related to the relaxation time ?

CBSE-2019

121. Two conductors, made of the same material have equal lengths but different cross-sectional areas A_1 and A_2 ($A_1 > A_2$). They are connected in parallel across a cell. Show that the drift velocities of electrons in two conductors are equal.

CBSE-2023

122. The potential difference applied across a given conductor is doubled. How will this affect (i) the mobility of electrons and (ii) the current density in the conductor? Justify your answers.

CBSE-2023

123. A potential difference V is applied across a conductor of length *l* and uniform cross-section area A. How will the **(i)** electric field E, **(ii)** drift velocity vd, and **(iii)** current density j be affected when **(a)** V is doubled and **(b)** *l* is halved (keeping other factors constant)?

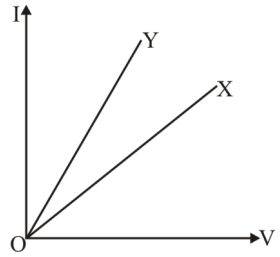
CBSE-2023

124. **(a)** Give the sequence of colour bands found on a 47 kΩ ± 10% carbon resistor.

(b) Write two properties of manganin which make it a suitable material for making standard resistors.

CBSE-2020

125. The I – V characteristics of two wires X and Y at constant temperatures are shown in the figure. The two wires have equal lengths and diameters. Which of them is made up of material of larger resistivity?



CBSE-2020

126. Carbon resistors are widely used in electronic circuits. Why? Write any two reasons.

Rajasthan Board-2022

127. Write the names of two substances, whose temperature coefficient of resistance α is negative.

Rajasthan Board-2011

128. The resistivity of a constantan wire is $49 \times 10^{-8}\Omega$ m. What is its conductivity?

Nagaland Board-2018

129. Define the term electrical resistivity of a material.

Nagaland Board-2017

130. Derive the relation between drift velocity of free electron and electric current flowing through a conductor.

Nagaland Board-2021

131. A silver wire has a resistance of 2.7 Ω at 100°C. Determine the temperature coefficient of resistivity of silver.

Nagaland Board-2020

132. Write the relation between resistance and resistivity of a conductor. Which of these quantities does not change for same material?

Haryana Board-2017

133. Define resistance of a conductor and give its relation with resistivity.

Haryana Board-2016

134. The tungsten filament of bulb has resistance equal to 18 Ω at 20°C temperature, 0.185 A of current flows, when 30 V is connected to it. If $\alpha = 4.5\times10^{-3}\ k^{-1}$ for a tungsten, then find the temperature of the filament. Assume that Ohm's law is obey.

Gujarat Board- May, 2021

135. The resistance of the platinum wire of a platinum resistance thermometer at the ice point is 5Ω and at steam point is 5.23Ω. When it is inserted in a hot bath, the resistance of the wire is 5.795 Ω. Calculate the temperature of the bath.

Gujarat Board- March, 2020
Uttarakhand Board-2020

136. What are the factors on which the resistance of a conductor depends? Give the corresponding relation.

Jharkhand Board-2020

Search On TG: @apna_pdf

137. A wire with an area of cross-section as $10mm^2$ has a resistance of 5Ω, when a potential difference across its ends is 25V. calculate the drift velocity of electrons. Given the number density of electrons as 5×10^{20} electrons per cubic meter (e/m^{-3}).

Punjab Board-2018

138. Define relaxation time of the free electrons drifting in a conductor. How it is related to the drift velocity of free electrons? Use this relation to deduce the expression for the electrical resistivity of the material.

CBSE All India-2012

139. **(i)** Derive the relation between current density J and potential difference V across a current carrying conductor of length *l*, area of cross-section A and the number density n of free electrons.

(ii) Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. [Assume that the number density of conduction electrons is 9×10^{28} m^{-3}]

CBSE Delhi-2012C

140. Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained?

CBSE Delhi-2011

141. Draw a plot showing the variation of resistivity of a (i) conductor and (ii) semiconductor, with the increase in temperature. How does one explain this behaviour in terms of number density of charge carriers and the relaxation time?

CBSE Delhi-2014 C

142. Derive an expression for the current density of a conductor in terms of the drift speed of electrons.

CBSE Foreign-2014

143. Define mobility of a charge carrier. Write the relation expressing mobility in terms of relaxation time. Give its SI unit.

CBSE All India-2013C

144. A conductor of length *l* is connected to a DC source of potential V. If the length of the conductor is tripled by gradually stretching it, keeping V constant, how will

(i) drift speed of electrons and

(ii) resistance of the conductor be affected? Justify your answer.

CBSE Foreign-2012

145. Two materials Si and Cu, are cooled from 300K to 60K. What will be the effect on their resistivity?

CBSE Foreign-2013

146. When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction?

CBSE Delhi-2012

147. Show on a graph, the variation of resistivity with temperature for a typical semiconductor.

CBSE Delhi-2012

148. Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker?

CBSE All India-2012

149. Define resistivity of a conductor. Write its SI unit.

Bihar Board-2022

CBSE All India-2011

150. A wire of resistance 8 Ω is bent in the form of a circle. What is the effective resistance between the ends of a diameter AB?

0CBSE Delhi-2010

151. Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice than that in Y, then find the ratio of drift velocity of electrons in the two wires.

CBSE All India-2010

152. Plot a graph showing the variation of resistance of a conducting wire as a function of its radius. Keeping the length of the wire and its temperature as constant.

CBSE Foreign-2013

153. Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature?

CBSE All India-2013

154. How does one explain increase in resistivity of a metal with increase of temperature?

CBSE All India-2014C

155. Show variation of resistivity of Si with temperature in graph.

CBSE Delhi-2014, 2012

156. Show variation of resistivity of copper as a function of temperature in graph.

CBSE Delhi-2014 , CBSE All India-2014

157. How does the random motion of free electrons in a conductor get affected when a potential difference is applied across its ends?

CBSE Delhi-2014

158. Plot a graph showing the variation of free electrons in a conductor get affected when a potential difference is applied across its ends?

CBSE Foreign-2015

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159. How is the drift velocity in a conductor affected with the rise in temperature?

CBSE Delhi-2019

160. The resistance of a platinum wire at 0°C is 4 Ω. What will be the resistance of the wire at 100°C if the temperature coefficient of resistance of platinum is 0.0038/°C?

Tamil Nadu Board-September, 2016

161. Define temperature coefficient of resistance.

Tamil Nadu Board-March, 2016

162. Define mobility. Give its unit.

CBSE-2023, 2020
Karnataka Board-July, 2020
Karnataka Board-March, 2017, 2014
Tamil Nadu Board-March, 2016
Assam Board-2016
CBSE Delhi-2014

163. The resistance of nichrome wire at 0^oC is 10Ω. If its temperature coefficient of resistance is $0.004/^oC$ find its resistance at boiling point of water.

Tamil Nadu Board-2018, 2015

164. The resistance of a platinum wire at 0°C is 4Ω. What will be the resistance of the wire at 100°C if the temperature coefficient of resistance of platinum is 0.0038/°C.

Tamil Nadu Board-2016

165. Define transition temperature in superconductivity.

Tamil Nadu Board-2016

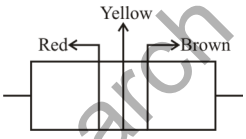
166. Obtain a relation between current and drift velocity.

Tamil Nadu Board-2022, 2016

167. Define electrical resistivity.

Tamil Nadu Board-2022, 2018

168. What is the resistance of a carbon resistor whose coloured bands are shown below in figure.



ISC-2010, 2001

169. Explain the statement 'temperature coefficient of resistance of metal is 4×10^{-3}/°C.

ISC-2010

170. A wire of resistivity ρ is stretched uniformly, so that its length becomes four times. What is its new resistivity ? (assume temperature of the wire remains constant during stretching of the wire.)

ISC-2008

171. Show graphically how electrical resistance of a piece of silicon or germanium varies when its temperature is varied.

ISC-2008

172. What is meant by drift speed of free electrons ?

ISC-2017

Section-C (Short Answer)

173. The resistance of one aluminium and one copper wires having identical lengths is equal. Which of the two wires will be lighter $\rho_{Al} = 2.63\times10^{-8}$ Ωm; $\rho_{Cu} = 1.72 \times10^{-8}$ Ωm the density of the aluminium is 2.7×10^3 kgm^{-3} and density of copper is 9×10^3 kgm^{-3}. **3**

Gujarat Board- May, 2021

174. Distinguish between resistance and resistivity.

J&K Board-2020

175. Arrive at an expression for drift velocity.

Karnataka Board-July, 2016

176. What is meant by drift velocity of electrons in a conductor? Establish relation between drift velocity and electric current for a conductor.

Uttarakhand Board-2023
Odisha Board-2023

177. How do you define mobility of a charge carrier in a conductor? Establish the following relation for mobility.

$$\mu = e\tau/m$$

Assam Board-2013

178. What is the drift speed of electrons in a conductor? Establish the following relation for drift speed where the symbols have their usual meaning.

$$v_d = \frac{eE}{m}r$$

Assam Board-2017

179. A 100W heater coil is rated 200V. Find the resistance of the coil.

Assam Board-2015

180. A copper wire is stretched so as to increase its length by 0.2%. Calculate the percentage change in the resistance of the wire.

Assam Board-2015

181. Find the resistance of a wire of length 10 m having a diameter of 1.3×10^{-3} m. (Assume the resistivity of the material of the wire to be 4.5×10^{-7} Ωm)

Meghalaya Board-2013

182. Explain the following :
(i) Drift Veloity
(ii) Relaxation Time
(iii) Potential Difference

Chhattisgarh Board-2019

184. Derive an expression for the drift velocity of conduction electrons, when electric field is applied.

NIOS-2021
Karnataka Board-July-2016

185. What is the colour code of a carbon resistor having a resistance of 470 Ω and a tolerance of 5% ?

ISC-2014

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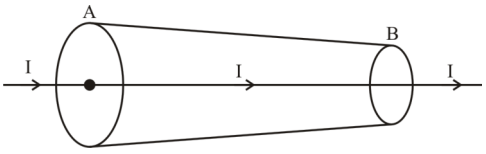
186. What do you understand by drift velocity of free electron ? Deduce Ohm's law on the basis of principle of drift velocity.

CBSE-2023
J&K Board-2021
UP Board-2019, 2018
Meghalaya Board-2018

187. A metallic plug AB is carrying a current I (see figure below). State how the drift velocity of free electrons varies from end A to B



ISC-2009

188. Write down a simple relationship to show the variation of resistance with temperature. Define temperature coefficient of resistance. In what way the temperature coefficient of carbon is different from that of the common conductors ?

ISC-2001

189. The current flowing through a conductor is given by $I = ne Av_d$.

(i) Identify each term in the equation.

(ii) Obtain an expression for V_d, if the current flowing through the conductor of length *l* has its ends maintained at a potential difference V volt.

ISC-2006

190. (a) (i) Explain how free electrons in a metal at constant temperature attain an average velocity under the action of an electric field. Hence obtain an expression for it.

(ii) Consider two conducting wires A and B of the same diameter but made of different materials joined in series across a battery. The number density of electrons in A is 1.5 times that in B. Find the ratio of drift velocity of electrons in wire A to that in wire B.

OR

(b) (i) A cell emf of (E) and internal resistance (r) is connected across a variable load resistance (R). Draw plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load.

(ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r are connected in parallel across a resistor R.

Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.

CBSE-2023

191. **(a)** Differentiate between electrical resistance and resistivity of a conductor.

(b) Two metallic rods, each of length L, area of cross A_1 and A_2, having resistivities ρ_1 and ρ_2 are connected in parallel across a d.c. battery. Obtain the expression for the effective resistivity of this combination.

CBSE-2020

192. Write the relationship between mobility and drift velocity in a current carrying conductor.

(a) Write the relationship between mobility and drift velocity in a current carrying conductor.

CBSE-2020

193. Two aluminum wires have their lengths in the ratio 2 : 3 and radii in the ratio 2 : 3 and radii in the ratio 1 : 3 these are connected in parallel across a battery of emf E and of negligible internal resistance .Find the ratio of drift velocities of the electrons in the two wires.

CBSE-2020

194. (a) Differentiate between the random velocity and the drift velocity of electrons in an electrical conductor. Give their order of magnitudes.

(b) A conductor of uniform cross-sectional area is connected across a dc source of variable voltage. Draw a graph showing variation of drift velocity of electrons (v_d) as a function of current density (J) in it.

CBSE-2020

195. The thickness of a conductor continuously decreases from its one end (A) to another end (B). It is connected across the terminals of a battery. What will be the effect on the value of

(a) electric field,
(b) current density, and
(c) mobility of the electron
at a point on the conductor as one moves from end A to end B ?

CBSE-2020

196. Calculate the resistivity of the material of a wire of length 1.0 m, diameter 0.4 m and having a resistance of 2.0 in ohm.

J&K Board-2014, 2015

197. Explain how resistance of a conductor varies with temperature.

J&K Board-2015, 2014

198. Derive relation between Current and Drift velocity.

J&K Board-2022, 2012

199. Find the resistivity of wire of length 2m. diameter 0.01 m and resistance 50 mΩ.

J&K Board-2022

200. A wire has a resistance of 10.5 Ω at 21°C and 16.4 Ω at 147°C. Find the value of co-efficient of resistance.

J&K Board-2023

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201. **A metallic wire of length *l* and resistance 5Ω is stretched to double its length. Find its new resistivity and new resistance. Assume that there is no change in the density on stretching.**

Nagaland Board-2017

202. **The resistance of a wire at ice point is 5Ω and at steam point it is 5.2Ω. When the wire is inserted in a hot bath the resistance is 5.4Ω. Calculate the temperature of hot bath.**

Haryana Board-2016

203. **Show an a plot, variation of resistivity of (i) a conductor and (ii) a typical semiconductor as a function of temperature.**

Using the expression for the resistivity in terms of number density and relaxation time between the collisions, explain how resistivity in the case of a conductor increases while it decreases in a semiconductor, with the rise of temperature.

CBSE All India-2019

204. **(i) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?**

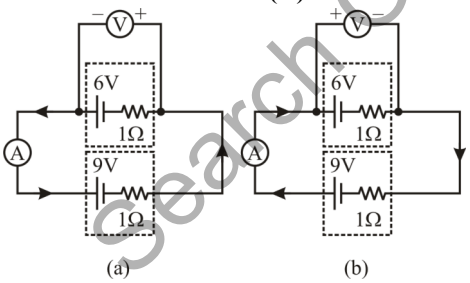
(ii) Why alloys like constantan and Manganin are used for making standard resistors?

CBSE Delhi-2016

205. **Find the relation between drift velocity and relaxation time of charge carriers in a conductor of length L is connected to a DC sources of emf E. If the length of the conductor is tripled by stretching it, keeping E constant, explain how its drift velocity would be affected.**

CBSE Delhi-2005

206. **In the two electric circuits shown in the figure, determine the readings of ideal ammeter (A) and the ideal voltmeter (V).**



CBSE All India-2015

207. **Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 2.5×10^{-7} m^2 carrying a current of 1.8 A. Assume the density of conduction electrons to be 9×10^{28} m^{-3}.**

CBSE All India-2014

208. **Using the concept of drift velocity of charge carriers in a conductor, deduce the relationship between current density and resistivity of the conductor.**

CBSE Delhi-2015C

209. **The resistance of a nichrome wire at 0ºC is 10Ω. If its temperature coefficient of resistance is 0.004/ºC, find its resistance at boiling point of water. Comment on the result.**

Tamil Nadu Board-2023

Section-D (Case-Based Questions)

210. **Show that for a current carrying conductor $I = nAeV_d$, where the symbols have their usual meanings.**

Meghalaya Board-2015

211. **Using the expressions for drift velocity (V_d) and current (*I*), show that $R = \frac{ml}{nAe^2\tau}$, Where the symbols have their usual meanings.**

Meghalaya Board-2014

212. **A wire of length L_o has a resistance R_o. It is gradually stretched till its length becomes $2L_o$.**

(a) Plot a graph showing variation of its resistance R with its length *l* during stretching.

(b) What will be its resistance when its length becomes 2 L_o?

CBSE-2020

Section-E (Long Answer)

213. **Derive $\sigma = \frac{ne^2T}{m}$ where the symbols have their usual meaning.**

Karnataka Board-July, 2018, 2015

214. **What do you understand by current density? Derive the relation between current density and conductivity. What will be effect on conductivity of a conductor on increasing its temperature?**

Uttarakhand Board-2019

215. **A metallic wire has a resistance of 50Ω at 20°C and 50.5Ω at 120°C. Calculate the temperature coefficient of resistivity of wire.**

NIOS-2022

216. **Explain drift velocity of free electrons in a metal. Find the formula relating drift velocity and current density.**

UP Board-2021

217. **A wire whose cross-sectional area is increasing linearly from its one end to the other, is connected across a battery of V volts. Which of the following quantities remain constant in the wire?**

(a) Drift speed (b) Current density

(c) Electric current (d) Electric field

Justify your answer.

CBSE Delhi-2017

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III. Resistance, Series and Parallel Combination of Resistor

Section-A (Multiple Choice Questions)

218. Moving charges produce,
(a) Electric field only
(b) Magnetic field only
(c) Both electric and magnetic fields
(d) None from both electric and magnetic fields

Uttarakhand Board-2023

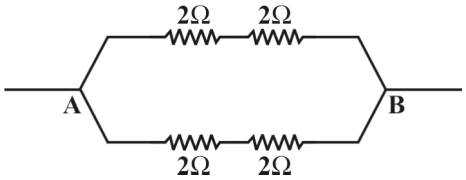
Ans. (c) :

219. A conductor of resistance R is stretched to two times its initial length, keeping the volume constant. What will be its new resistance?
(a) 2R (b) R/2
(c) 4R (d) R

Meghalaya Board-2023

Ans. (c) :

220. The equivalent resistance between point A and B given in figure.



(a) 8 ohm (b) 4 ohm
(c) 2 ohm (d) 1 ohm

MP Board-2020

Ans. (c) :

221. A uniform wire of resistance 2R is bent in the form of a circle. The effective resistance between the ends of any diameter of the circle is:
(a) 2R (b) R
(c) $\frac{R}{2}$ (d) $\frac{R}{4}$

CBSE-2020

Ans. (c) :

222. "Ohm-metre" is unit of:
(a) Resistance (b) Current density
(c) Resistivity (d) Conductivity

Haryana Board-2022

Ans. (c) :

223. The resistivity of a conductor with increase in temperature:
(a) decreases
(b) increases
(c) remains same
(d) may increase or decrease

Haryana Board-2017

Ans. (b) :

224. For series combination total resistance R will be :
(a) $R = R_1 + R_2 + R_3 + ...$
(b) $R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$
(c) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$
(d) $R = R_1 R_2 R_3 .....$

Haryana Board-2016

Ans. (a) :

225. Which of the following can be used as 'shunt' ?
(a) High resistance (b) Low resistance
(c) Both (d) None

Haryana Board-2016

Ans. (b) :

226. Three resistors 4Ω, 8Ω, and 10Ω are combined in parallel. What is the total resistance of the combination?
(a) 2.10 Ω (b) 19/20 Ω
(c) 1.05Ω (d) 22Ω

Gujarat Board- August, 2020

Ans. (a) :

227. n resistors each of equal value R combine to get maximum and minimum effective resistance. The ratio of maximum effective resistance to the minimum effective resistance is.
(a) $\frac{1}{n}$ (b) n^2
(c) n (d) $\frac{1}{n^2}$

Gujarat Board-March, 2022

Ans. (b) :

228. If a uniform wire of resistance 16Ω is cut into four equal parts and attached in parallel combination the equivalent resistance is
(a) 1Ω (b) 4Ω
(c) $\frac{1}{4}\Omega$ (d) $\frac{1}{16}\Omega$

Jharkhand Board-2020

Ans. (a) :

229. A uniform wire of resistance R is cut into n equal parts. These parts are then connected in parallel with each other. The equivalent resistance of the combination is
(a) $\frac{R}{n^2}$ (b) nR
(c) $\frac{R}{n}$ (d) $\frac{n}{R^2}$

Jharkhand Board-2019

Ans. (a) :

Search On TG: @apna_pdf

230. An ideal voltmeter has:
(a) zero resistance
(b) finite resistance less than G but greater than zero
(c) resistance greater than G but less than infinity
(d) infinite resistance

Tamil Nadu Board-March, 2016

Ans. (d) :

231. When two 2 Ω resistances are in parallel, the effective resistance is
(a) 2 Ω (b) 4 Ω
(c) 1 Ω (d) 0·5 Ω

Tamil Nadu Board-2011

Ans. (c) :

Section-B (Very Short Answer)

232. The unit of Resistance is …….

Haryana Board-2022

233. A wire of resistance R is stretched to thrice its original length keeping the volume constant. Calculate its new resistance.

Meghalaya Board-2015

234. A resistor is marked with colours red, red , orange and gold. Write the value of its resistance.

Karnataka Board- March, 2015

235. How does the resistance of a conductor vary with its length?

Karnataka Board-July, 2019

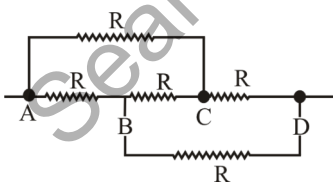
236. Three resistance R_1, R_2 and R_3 are connected in parallel. Derive an expression for their equivalent resistance.

Uttarakhand Board-2019

237. Two resistors of resistance ratio 3:4 are connected in parallel. Compare the magnitude of heat produced in then.

Bihar Board-2019

238. Find the equivalent resistance between A and D.



Assam Board-2014

239. Two resistors of equal values are connected in parallel. Which of the following options is correct if the two ends of the combination are connected across the terminals of a battery?
(i) $i_1 = i_2$ (currents flowing through the resistors)
(ii) $V_1 = V_2$ (potential differences across each resistors)
(iii) Both of the above are. correct.

Assam Board-2023

240. On a resistor, the four colour bands are green, violet, red and gold. Give the complete information about the resistor.

Assam Board-2017

241. Three resistors R_1, R_2, R_3 are to be combined as shown in the figures.

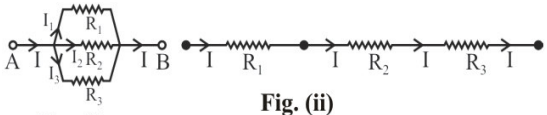


Fig. (i)

(a) Identify the series and parallel combinations.
(b) Which combination has lowest effective resistance?
(c) Arrive at the expression for the effective resistance of parallel combination.

Kerala Board-2020

242. Draw a graph showing the relation between resistivity and temperature of a super conductor.

Kerala Board-2013

243. As the temperature of a metallic resistor is increased; the product of its resistivity and conductivity_____
(i) Increases
(ii) Decreases
(iii) Remains constant
(iv) May increase or decrease

Kerala Board-2013

244. To construct an, electronic circuit, you want to select a 470KΩ resistor with 5% tolerance. Draw a schematic diagram indicating the colour combinations that you will select.

Kerala Board-2013

245. A wire of resistance 1000 Ω and length *l* is increased to twice its original length. Calculate its new resistance.

Meghalaya Board-2019

246. Calculate the equivalent resistance of the resistances 1 Ω and 3Ω connected in series.

Meghalaya Board-2015

247. What is the value of resistance for an ideal voltmeter?

Maharashtra Board-2023

248. Three resistors r_1, r_2, r_3, are joined in series. Draw labelled diagram and obtain expression for its equivalent resistance.

MP Board-2013

249. If length of a wire is doubled after stretching, then what will be its resistance?

MP Board-2013

250. How should the resistances 2, 3 and 6Ω be connected so that the equivalent resistance is 4Ω? Also draw a diagram of the combination.

MP Board-2018

Search On TG: @apna_pdf

251. **Three resistances r_1, r_2 and r_3 joined in parallel. Draw circuit diagram and derive expression for equivalent resistance.**

MP Board-2019

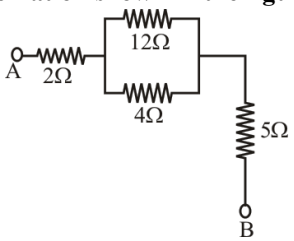
252. **How should the resistances 2Ω, 3Ω and 6Ω be connected so that the equivalent resistance is 4Ω ? Also draw a diagram of the combination.**

MP Board-2021

253. **A light bulb is rated at 200 W for a 220 V supply. Find the resistance of the bulb.**

MP Board-2023

254. **Find equivalent resistance between A and B in the combination shown in the figure**



NIOS-2018

255. **A resistor R is connected to a cell of emf e and internal resistance r. Potential difference across the resistor R is found to be V. state the relation between e, V, R, and r.**

ISC-2015

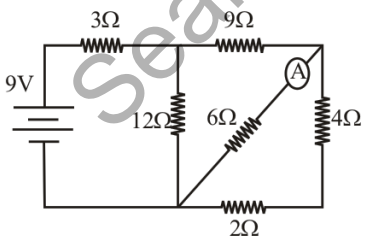
256. **Three identical cells each of emf 2V and internal resistance 1Ω are connected in series to form a battery. The battery is then connected to a parallel combination of two identical resistors, each of resistance 6Ω. Find the current delivered by the battery.**

ISC-2015

257. **A 2V battery with internal resistance of 0.1Ω is charged with a current of 5A. Calculate the potential difference between the terminals of the battery.**

ISC-2005

258. **In the circuit shown in the figure, find the value of the current shown in the ammeter A.**



CBSE-2019

259. **A set of 'n' identical resistors, each of resistance 'R' when connected in series have an effective resistance 'X'. When they are connected in parallel, their effective resistance becomes 'Y'. Find out the product of X and Y.**

CBSE-2019

260. **Why are resistances connected in series and in parallel?**

J&K Board-2023

261. **Why are connecting wires made of copper?**

J&K Board-2023

262. **A cylindrical wire having 10Ω resistance is stretched to increase its length by 10%. Calculate its new resistance.**

Gujarat Board- March, 2019

263. **At room temperature (27ºC) the resistance of heating element is 100 Ω. What is the temperature of the element if the resistance is found to be 134 Ω, given that the temperature coefficient of material of the resistor is 1.7×10^{-4} ºC^{-1} ?**

Gujarat Board-2023

264. **Derive an equivalent resistance for the series connection of resistors.**

Gujarat Board- July, 2022

265. **(i) You are required to select a carbon resistor of resistance 47 kΩ ± 10% from a large collection. What should be the sequence of colour bands used to code it?**

(ii) Write the characteristics of manganin which make it suitable for making standard resistance.

CBSE Delhi-2011, CBSE Foreign-2011

266. **The sequence of coloured bands in two carbon resistors R_1 and R_2 is**

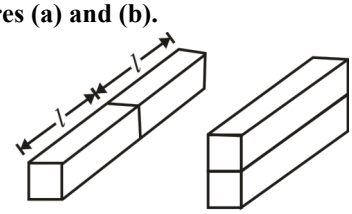
(a) brown, green blue and

(b) orange, black, green.

Find the ratio of their resistances.

CBSE Delhi-2010C

267. **Two identical slabs, of a given metal, are joined together, in two different ways, as shown in figures (a) and (b).**



(a) (b)

What is the ratio of the resistances of these two combinations?

CBSE Delhi-2010C

268. **If the potential difference applied across a variable resistor is constant, draw a graph between the current in the resistor and the resistance.**

ISC-2000

269. **A battery of e.m.f. 10V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 0.5 A, what is the resistance of the resistor?**

Jharkhand Board-2018

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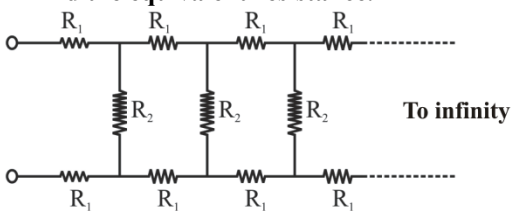
Section-C (Short Answer)

270. You have been given n resistors each of value R. How will you combine them to get (i) maximum and (ii) minimum effective resistance ? Mention the values in each case. Find the ratio of maximum to minimum values of resistance.

Assam Board-2023

271. As shown in the diagram, network of resistors R_1 and R_2 extends off to infinity to the right. Find the equivalent resistance.

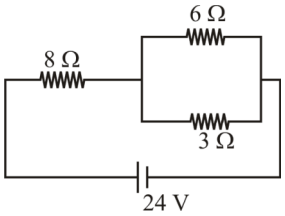


Assam Board-2017

272. In the figure shown below

(a) Which are the resistors connected in parallel ?

(b) Calculate the current drawn from the cell.



Kerala Board-2021

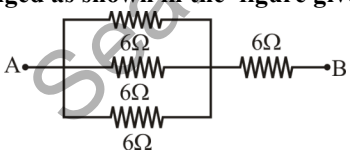
273. Resistors are sometimes joined together and they have several applications in electronics.

(a) Draw a series combination of three resistors R_1, R_2, and R_3.

(b) Obtain the expression for the effective resistance in the combination of two resistors R_1 and R_2 in parallel. Sketch the combination also.

Kerala Board-2014

274. Four equal resistances each of 6 ohms are arranged as shown in the figure given below:



Calculate the total resistance between A and B.

Kerala Board-2016

275. A metal wire of resistance 'R' and length '*l*' is bent to form a circular loop. L and M are two diametrically opposite points of the loop.

(i) What is the equivalent resistance across the points L and M?

(ii) How will the resistance across the points L and M change, if the temperature of the loop is increased?

Goa Board-2018

276. Two resistances R_1 and R_2 are connected with a battery of V volts. Compute the net resistance, when they are connected first (a) in series and then (b) in parallel. Draw circuit diagrams for each.

NIOS-2021

277. A wire of resistance 10 ohms is stretched to double its original length. Calculate its new resistance.

J&K Board-2017

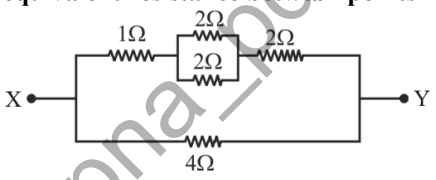
278. A wire of resistance 5Ω drawn out so that its length is increased to twice its original length. Calculate its new resistance.

J&K Board-2016

279. A wire of resistance one ohm is stretched to double its length what is the new resistance of the wire?

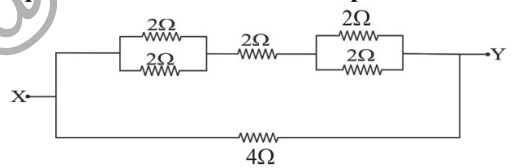
J&K Board-2012

280. Define resistance of a conductor and calculate equivalent resistance between points X and Y:



Haryana Board-2017

281. Define resistance of a conductor and calculate equivalent resistance between points X and Y.



Haryana Board-2017

282. A heating element using nichrome connected to a 230 V supply draws an initial current of 4.6 A which settles after a few seconds to a steady value of 2.3 A. What is the steady temperature of the heating element if the room temperature is 27 ºC. [$\alpha = 1.7 \times 10^{-4}$ ºC^{-1}]

Gujarat Board-March, 2022

283. A battery of V volt and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 equal resistors each of resistance R Ω. Determine the equivalent resistance of the network.

Gujarat Board- July, 2022

284. A metal rod of square cross-sectional area A having length *l* has current I flowing through it when a potential difference of V volt is applied across its ends (figure I). Now the rod is cut parallel to its length into two identical pieces and jointed as shown in figure II. What potential difference must be maintained across the length of 2 *l* so that the current in the rod is still I?

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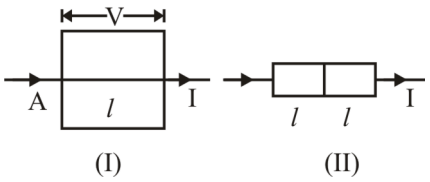


CBSE Foreign-2016

Section-D (Long Answer)

285. Two resistors are connected in series with 5V battery of negligible internal resistance. A current of 2A flows through each resistor. If they are connected in parallel with the same battery a current of $\frac{25}{3}$A flows through combination. Calculate the value of each resistance.

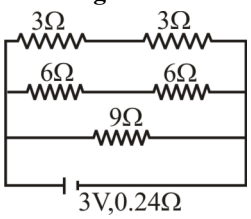
Karnataka Board-March, 2019

286. a) Three resistors of resistances 2Ω, 3Ω and 4Ω combined in series. What is the total resistance of the combination?

b) If this combination is connected to a battery of emf 10 V and negligible internal resistance, obtain the potential drop across each resistor.

Karnataka Board-March, 2016

287. In the given circuit diagram, calculate: (i) The main current through the circuit and (ii) Also current through 9 Ω resistor.



Karnataka Board-July, 2018

288. A wire having length 2.0 m, diameter 1.0 mm and resistivity 1.96×10^{-8} Ωm is connected in series with a battery of emf 3V and internal resistance 1Ω. Calculate the resistance of the wire and current in the circuit.

Karnataka Board-July, 2016

289. With the help of a circuit diagram, obtain the expression for equivalent resistance of two resistors connected in parallel.

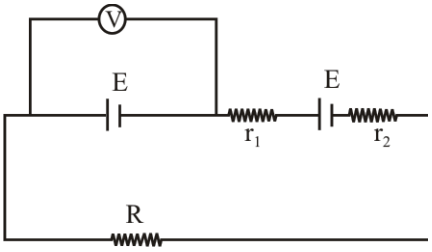
Karnataka Board-March, 2014, 2015

290. R_1, R_2 and R_3 are three resistors. Parallel combination of R_2 and R_3 is connected to R_1 in series. If V be the potential difference between the end points of the mixed combination, then show that the total current flowing in the circuit is -

$$I = \frac{V(R_2 + R_3)}{R_1R_2 + R_1R_3 + R_2R_3}$$

Assam Board-2023

291. Two cells of same emf E, but different internal resistances r_1 and r_2 connected to an external resistance R as shown in the figure given below. The voltmeter V reads zero. Obtain an expression for R in terms of r_1 and r_2. Calculate the voltage across the cell of internal resistance r_2. (Assume that the voltmeter V is of infinite resistance).



ISC-2005

IV. Electrical Energy and Power

Section-A (Multiple Choice Questions)

292. 1 kWh is equal to :

(a) 3.6×10^5 J (b) 3.6×10^{-6} J
(c) 3.6×10^6 J (d) 36000 J

J&K Board-2020

Ans. (c) :

293. Power of an electric - circuit is -

(a) V.R (b) V^2. R
(c) $\frac{V^2}{R}$ (d) V^2 Rt

Bihar Board-2019

Ans. (c) :

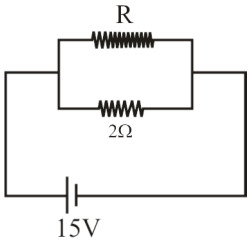
294. When two bulbs of power 60 W and 40 W are connected in series, then the power of their combination will be.

(a) 100 W (b) 2400 W
(c) 30 W (d) 24 W

Bihar Board-2019

Ans. (d) :

295. If in the following circuit, power dissipated is 150 W, then R is



(a) 2 Ω (b) 6 Ω
(c) 5 Ω (d) 4 Ω

Meghalaya Board-2018

Ans. (b) :

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296. A conductor of 10Ω is connected across a 6 V ideal source. The power supplied by the source to the conductor is

(a) 1.8 W (b) 2.4 W
(c) 3.6 W (d) 7.2 W

CBSE-2023

Ans. (c) :

297. Two resistors R_1 and R_2 of 4 Ω are connected in parallel across a battery. The ratio of power dissipated in them $P_1 : P_2$ will be

(a) 4 : 9 (b) 3 : 2
(c) 9 : 4 (d) 2 : 3

CBSE-2020

Ans. (b) :

298. An electric bulb is rated 220 volt, 100 watt. Power consumed by it when operated on 110 volt is

(a) 50 watt (b) 75 watt
(c) 90 watt (d) 25 watt

Nagaland Board-2018

Ans. (d) :

299. If the current in an electric bulb increases by 1%, what will be the change in the power of a bulb ?
[Assume that the resistance of the filament of a bulb remains constant]

(a) Increases by 2% (b) decreases by 1%
(c) increases by 1% (d) decreases by 2%

Gujarat Board- May, 2021

Ans. (a) :

Section-B (Very Short Answer)

300. A heating element connected to a 12V battery draws a current of 5 A. How much electric power is supplied?

Meghalaya Board-2023

301. Power of 60 W is being supplied to an electrical appliance, under a potential difference of 240V. What is the current flowing through the appliance?

Meghalaya Board-2023, 2014

302. Compare the resistances of two bulbs of 50 watt and 200 watt if they are at the same voltage.

MP Board-2019

303. Three bulbs of specifications 60 W/220 V, 100 W/220 V and 1000 W/220 V are connected in series. Which one will glow the brightest ?

ISC-2004

304. The maximum power dissipated in a 10000Ω resistor is 10W. What is the maximum current ?

ISC-2001

305. Two resistors R_1 = 60Ω and R_2 = 90Ω are connected in parallel. If electric power consumed by the resistor R_1 is 15 W, calculate the power consumed by the resistor R_2.

ISC-2017

306. Two resistor R_1 = 400Ω and R_2 = 20Ω are connected in the parallel to a battery. If heating power developed in R_1 is 25 W, find the heating power developed in R_2.

ISC-2015

307. Calculate the power loss in the form of heat when a power of 11,000 W is transmitted at 220 V.

Tamil Nadu Board-September, 2016

308. Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Which wire gets heated up more? Justify your answer.

CBSE All India-2017

Section-C (Short Answer)

309. Define Electric Power and Electric Energy. Give their units.

J&K Board-2011

310. A 50 watt and 100 volt lamp is connected to electric mains of 200 volt and 50 Hertz. Find the capacity of condenser required in the series of lamp in order to glow it.

UP Board-2022

V. Cell, emf, Internal Resistance, Cells in Series and in Parallel

Section-A (Multiple Choice Questions)

311. The e.m.f of a cell is measured by

(a) a voltmeter (b) a galvanometer
(c) an ammeter (d) a potentiometer

Bihar Board-2022

Ans. (d) :

312. Two bulbs (25 W, 220 V) and (100 W, 220 V) are given. Which has higher resistance ?

(a) 25 W
(b) 100 W
(c) both have equal resistance
(d) none of these

Bihar Board-2022

Ans. (a) :

313. When two bulbs of power 60 W and 40 W are connected in series, then the power of their combination will be

(a) 100 W (b) 2400 W
(c) 30 W (d) 24 W

Bihar Board-2022

Ans. (d) :

314. The resistance of a wire is R. If the diameter of the wire is halved by stretching it then the resistance of the wire will become

(a) 2R (b) 4R
(c) 8R (d) 16R

Bihar Board-2022

Ans. (b) :

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315. Assertion (A) : When three electric bulbs of power 200 W, 100 W and 50 W are connected in series to a source, the power consumed by the 50 W bulb is maximum.

Reason (R) : In a series circuit, current is the same through each bulb, but the potential difference across each bulb is different.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.

CBSE-2023

Ans. (b) :

316. The emf and internal resistance of a cell are E and r respectively. It is connected across an external resistance R = 2r. The potential drop across the terminals of the cell will be :

(a) $\frac{E}{4}$ (b) $\frac{E}{2}$
(c) $\frac{2}{3}E$ (d) $\frac{E}{3}$

CBSE-2023

Ans. (b) :

317. A battery of emf E and internal resistance r is connected to an external circuit. The potential drop within the battery is proportional to :

(a) current in the circuit
(b) total resistance of the circuit
(c) emf of the battery
(d) power dissipated in the circuit

CBSE-2023

Ans. (c) :

318. A cell of emf E is connected across an external resistance R. When current 'I' is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The internal resistance 'r' of the cells is

(a) $\left(\frac{E-V}{E}\right)R$ (b) $\left(\frac{E-V}{R}\right)$
(c) $\frac{(E-V)R}{I}$ (d) $\left(\frac{E-V}{V}\right)R$

CBSE-2023

Ans. (d) :

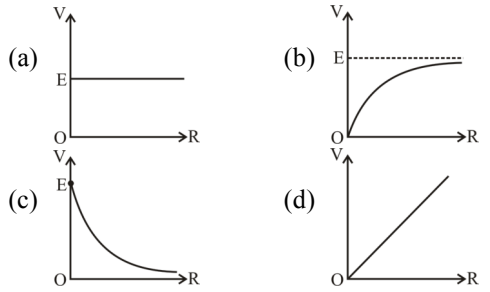
319. The potential difference across a cell in an open circuit is 8 V. It falls to 4 V when a current of 4 A is drawn from it. The internal resistance of the cell is :

(a) 4Ω (b) 3Ω
(c) 2Ω (d) 1Ω

CBSE-2023

Ans. (c) :

320. A cell of emf (E) and internal resistance r is connected across a variable external resistance R. The graph of terminal potential difference V as a function of R is-



CBSE-2020

Ans. (b) :

321. A cell of internal resistance r connected across an external resistance R can supply maximum current when

(a) R = r (b) R > r
(c) $R = \frac{r}{2}$ (d) R = 0

CBSE-2020

Ans. (a) :

322. Two unequal resistors are connected in series across a battery. Then the

(a) potential difference across each resistor is the same.
(b) current in the smaller resistor is larger.
(c) potential difference across the bigger resistor is greater.
(d) power dissipated in both resistors is the same.

CBSE-2020

Ans. (c) :

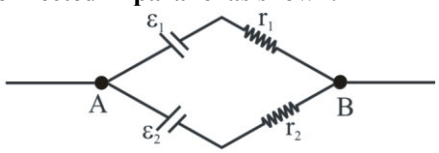
323. The storage battery of a car emf 12V. If the internal resistance of the battery is 0.4 Ω. What is the maximum current that can be drawn from the battery?

(a) 0.3A (b) 30.A (c) 3A (d) 0.03A

Gujarat Board- August, 2020

Ans. (b) :

324. Two batteries of emf ε_1 & ε_2 ($\varepsilon_2 > \varepsilon_1$) and internal resistance r_1 & r_2 respectively are connected in parallel as shown.



(a) The equivalent emf is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$
(b) The equivalent emf ε_{eq} is smaller that ε_1
(c) The equivalent emf ε_{eq} of the two cells is between ε_1 & ε_2 i.e. $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$
(d) ε_{eq} is independent of internal resistance r_1 & r_2

Gujarat Board-2023

Ans. (c) :

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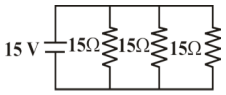
325. In India electricity is supplied for domestic use at 220 V. It is supplied at 110 V in USA. If the resistance of a 60 W bulb for use in India is R, the resistance of a 60 W bulb for use in USA will be :

(a) R/4 (b) R
(c) R/2 (d) 2R

Tamil Nadu Board-2022

Ans. (a) :

326. The current in the circuit is:



(a) 4A (b) 1 A
(c) 2A (d) 3A

Tamil Nadu Board-2023

Ans. (d) :

Section-B (Very Short Answer)

327. A battery of emf 10 V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 0.5 A, what is the resistance of the resistor?

Uttarakhand Board-2022

328. What do you understand by internal resistance of a Cell ?

Uttarakhand Board-2022

329. Name the type of combination of cells used to get maximum current when the external resistance is very high compared to the total internal resistance of the cells.

Meghalaya Board-2015

330. Write four points of difference between e.m.f. (Electromotive Force) and Potential difference.

MP Board-2012

331. Establish the relationship between electromotive force, terminal voltage and internal resistance.

MP Board-2019, 2018

332. Find the resultant resistance of 1Ω, 2Ω and 3Ω resistance connected in series and parallel combination.

MP Board-2020

333. The storage battery of a car has an emf of 12V. If the internal resistance of the battery is 0.4Ω, what is the maximum current that can be drawn from the battery?

MP Board-2020
Nagaland Board-2020

334. By connecting the electrodes of a cell to a resistance of 20 ohms, its potential difference remains from 50 volts to 40 volts. Calculate the internal resistance of the cell.

Chhattisgarh Board-2022

335. If internal resistance of each cell is much greater than the external resistance, which combination gives the maximum current? Explain.

Chhattisgarh Board-2020

336. A battery of e.m.f. 10 V and internal resistance 3Ω is connected to a external resistor. If the current in the circuit is 0.5A, Calculate the–
(i) external resistor and
(ii) terminal voltage of the battery.

NIOS-2019

337. Two batteries of e.m.f E_1 and E_2 having internal resistance r_1 and r_2 are connected in parallel. Find the e.m.f (E) and internal resistance of the equivalent battery.

UP Board-2021

338. A wire of resistance R, length *l* and uniform area of cross-section A is stretched till its length becomes double. It is then cut into three pieces of equal length which are connected in parallel. Find the net resistance of the combination in terms of the resistance R.

CBSE-2019

339. A wire of resistance R, length *l* and area of cross-section A, is cut into two parts, having their lengths in the ratio 1 : 2. The shorter wire is now stretched till its length becomes equal to that of the longer wire. If they are now connected in parallel, find the net resistance of the combination.

CBSE-2019

340. Why is the terminal voltage of a cell generally less than the emf of the cell?

CBSE-2019

341. Under what condition will the current in a wire be the same when connected in series and in parallel of n identical cells each having internal resistance r and external resistance R?

CBSE-2019

342. Two bulbs are rated (P_1, V) and (P_2, V). If they are connected (i) in series and (ii) in parallel across a supply V, find the power dissipated in the two combination in terms of P_1 and P_2.

CBSE-2019

343. A cell of emf E and internal resistance r is connected to a variable resistance R. Draw plots showing the variation of (a) terminal voltage V with R, and (b) V with current I, in the circuit.

CBSE-2023

344. Two identical cells, each of emf E and internal resistance r, are connected with a load resistance R, first in series and then in parallel. Obtain the condition under which the current through R is same in both cases.

CBSE-2023

345. Write two differences between the emf and terminal potential difference of a cell. What is the most important precaution that one should take while drawing current from a cell ?

CBSE-2023

346. (a) Define internal resistance of a cell.
(b) A cell of emf E and internal resistance r is connected across a variable resistor R. Plot the shape of graphs showing variation of terminal voltage V with (i) R and (ii) circuit current I.

CBSE-2020

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347. A uniform wire is cut into three parts with their lengths in the ratio 2:3:6. The ends of each of these three part are connected across an ideal battery of 10V. If a current of 5A is drawn from the battery, find the initial resistance of the wire.

CBSE-2020

348. A battery of emf 12 V and internal resistance 4Ω is connected to an external resistance R. If the current in the resistance is 0.5 A. Calculate the value of (a) R, and (b) the terminal voltage of the battery.

CBSE-2020

349. A cell of emf 'E' and internal resistance 'r' is connected across a variable external resistor 'R'. Plot the variation of voltage drop 'V' across the resistor as a function of 'R'.

CBSE-2020

350. If two cells of e.m.f ε_1, ε_2 and internal resistance r_1, r_2 are connected in parallel combination, then write the equivalent e.m.f. of this combination.

Rajasthan Board-2022

351. In a calibration of a voltmeter, a standard cell of e.m.f. 1.1 volt is balanced at 5.5 m length. If current of 0.11 A flows in a resistance of 2.3 Ω on what length the potential difference developed at its ends will balance? If the voltmeter reads this reading 0.25 volts, calculate the error in its reading.

Rajasthan Board-2011

352. What is the difference between electromotive force and terminal voltage of a cell? How are they related with each other?

Rajasthan Board-2011

353. Derive the expression for equivalent emf (E_{eq}) for the cell in series combination.

Nagaland Board-2020

354. Define internal resistance of a cell and give the factors affecting internal resistance.

Haryana Board-2016

355. Define internal resistance of a cell. State two factors on which it depends.

Jharkhand Board-2019

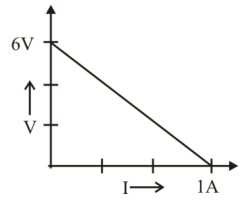
356. A heating element is marked 210V, 630 W. What is the value of the current drawn by the element when connected to a 210V DC source?

CBSE Delhi-2013

357. Two cells of emfs 1.5V and 2.0V having internal resistances 0.2 Ω and 0.3 Ω respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell.

CBSE Delhi-2014

358. The plot of the variation of potential difference across a combination of three identical cells in series versus current is shown below. What is the emf and internal resistance of each cell?

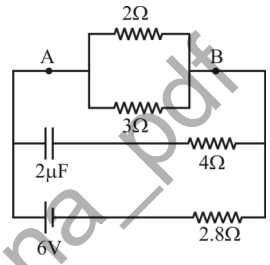


CBSE Delhi-2014

359. Two identical cells, each of emf E, having negligible internal resistance, are connected in parallel with each other across an external resistance R. What is the current through this resistance ?

CBSE All India-2013

360. Calculate the steady current through the 2Ω resistor in the circuit shown in the figure.



CBSE Foreign-2010

361. Distinguish between primary cell and secondary cell.

Tamil Nadu Board-September, 2016

362. A 10 Ω resistance is connected in series with a cell of emf 10V. A voltmeter is connected in parallel to a cell, and it reads 9.9V. Find the internal resistance of the cell.

Tamil Nadu Board-March, 2016

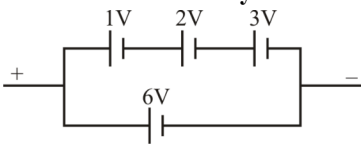
363. Describe the experiment to determine the internal resistance of a cell using voltmeter.

Tamil Nadu Board-2015

364. Compare em*f* and potential difference.

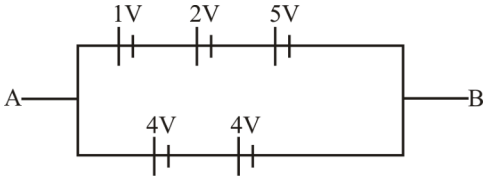
Tamil Nadu Board-2011

365. Find the emf of the battery shown in the figure.



ISC-2014

366. Figure below shows five DC sources (cells). Their emfs are shown in the figure.



Emf of the battery AB is

(a) 8V (b) 16V
(c) 4V (d) 2V

ISC-2012

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Section-C (Short Answer)

367. **Establish the following relation for current flowing through a circuit containing an external resistance R, a battery of e.m.f. E and internal resistance r**

$$i = \frac{E}{R + r}$$

Assam Board-2013

368. **(i) Establish the expression for current either I_1 or I_2 which are flowing through the resistors R_1 and R_2 respectively and connected in parallel to a cell of e.m.f. E and total current is I (i.e. $I_1 + I_2$).**

Assam Board-2023

369. **A battery of emf 2V and internal resistance 1Ω is used to send a current through a potentiometer wire of length 200cm and resistance 4Ω. What length of the wire will be required to balance a cell of emf 1.08V?**

Assam Board-2016

370. **A current of 0.3 Amp is flowing by connecting a 60 ohm resistance with the terminals of a battery. When resistance is decreased to 30 ohm the current becomes 0.5 Amp. Calculate electro-motive force and internal resistance of battery.**

Uttarakhand Board-2020

371. **Deduce the condition for obtaining the maximum current through an external resistance, when the cells are connected in mixed grouping.**

Meghalaya Board-2017

372. **Two cells of emf 4V and 2V having respective internal resistance of 1Ω and 2Ω are connected in parallel, so as to send current in the same direction through an external resistance of 5Ω. Find the current through the external resistance.**

Maharashtra Board-2022

373. **Derive an equation to determine the internal resistance of a cell by using a potentiometer. Draw necessary circuit diagram. Why is potentiometer preferred over voltmeter for comparison of e.m.f. of cells ?**

Goa Board-2019

374. **Establish the relation among electromotive force, potential difference and internal resistance of a cell.**

MP Board-2022

375. **Write any three difference between electromotive force and potential difference.**

MP Board-2023

376. **Write the definition of electromotive force of a cell and relate it to its internal resistance.**

Chhattisgarh Board-2021

377. **(i) A cell of emf (E) and internal resistance (r) is connected across a variable load resistance (R). Draw a plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load.**

(ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r are connected in parallel across a resistor R.

Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.

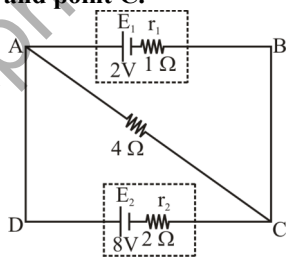
CBSE-2023

378. **Two cells of emf E_1 and E_2 and internal resistances r_1 and r_2 are connected in parallel, with their terminals of the same polarity connected together. Obtain an expression for the equivalent emf of the combination.**

CBSE-2023

Karnataka Board-March-2019

379. **A cell of emf E_1 = 2 V and internal resistance r_1 = 1 Ω is connected to another cell of emf E_2 = 8 V and internal resistance r_2 = 2 Ω through an external resistance of 4Ω as shown in the figure. Find the potential difference between point A and point C.**



CBSE-2020

380. **A battery of e.m.f 10 V and internal resistance 3 Ω is connected to a resistor so that a current of 0.5 A flows in the circuit. Find the resistance of resistor and terminal voltage of battery. In a closed circuit.**

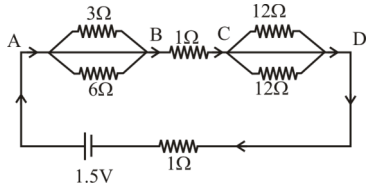
J&K Board-2022

Nagaland Board-2017

381. **A network of resistors is connected to a 15 V battery with internal resistance 1Ω as shown in figure.**

(a) Compute the equivalent resistance of the network.

(b) Obtain current in 12 Ω & 6Ω resistance.



Gujarat Board-2023

382. **Explain with circuit diagram the parallel combination of identical cells. Obtain the condition for maximum current in the external resistance connected with the combination.**

Jharkhand Board-2019

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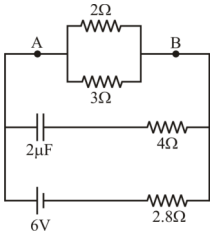
383. Define e.m.f of a cell. How can you compare the emf of two cells using potentiometer?

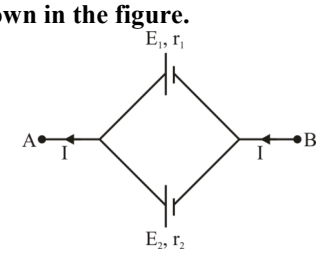
Punjab Board-2018

384. Calculate the steady current through the 2Ω resistor in the circuit shown in the figure below.



CBSE Foreign-2010

385. Two cells of emf E_1, E_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure.



Deduce the expressions for

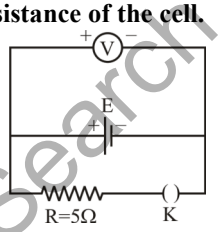
(i) the equivalent emf of the combination.

(ii) the equivalent resistance of the combination and

(iii) the potential difference between the points A and B.

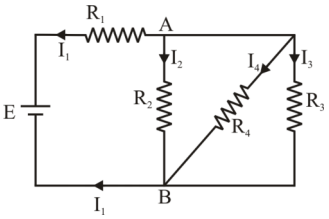
CBSE Foreign-2010

386. Write any two factors on which internal resistance of a cell depends. The reading on a high resistance voltmeter, where a cell is connected across it, is 2.2V. When the terminals of the cell are also connected to a resistance of 5Ω as shown in the circuit, the voltmeter reading drops to 1.8. Find the internal resistance of the cell.



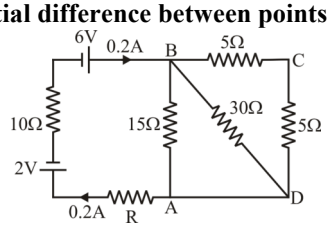
CBSE All India-2010

387. In the circuit shown, $R_1 = 4\Omega$, $R_2 = R_3 = 15\Omega$, $R_4 = 30\Omega$, and E = 10V. Calculate the equivalent resistance of the circuit and the current in each resistor.



CBSE Delhi-2011

388. Calculate the value of the resistance R in the circuit shown in the figure, so that the current in the circuit is 0.2A. What would be the potential difference between points A and B?



CBSE All India-2012

389. A cell of emf E and internal resistance r is connected across a variable load resistor R. Draw the plots of the terminal voltage V versus (i) resistance R and (ii) current I.

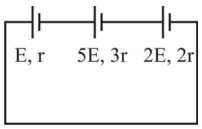
It is found that when R = 4 Ω, the current is 1A and when R is increased to 9Ω, the current reduces to 0.5A. Find the values of the emf E and internal resistance r.

CBSE All India-2015

390. Two cells of emf 2E and E and internal resistances 2r and r respectively, are connected in parallel. Obtain the expressions for the equivalent emf and the internal resistance of the of the combination.

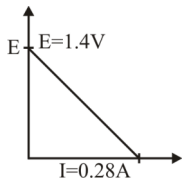
CBSE All India-2010C

391. Three cells of emf E, 2E and 5E having internal resistances r, 2r and 3r, variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R.

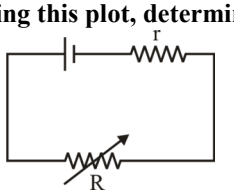


CBSE All India-2010C

392.



A straight line plot showing the terminal potential difference (V) of a cell as a function of current (I) drawn from it is shown in the figure. Using this plot, determine



Current in circuit, $i = \frac{E}{R+r}$

(i) the emf and

(ii) internal resistance of the cell.

CBSE Delhi-2011C

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393. A cell of emf E and internal resistance r is connected across a variable resistor R. Plot a graph showing variation of terminal voltage V of the cell versus the current I. Using the plot, show the emf of the cell and its internal resistance can be determined.

CBSE All India-2014

394. Distinguish between emf (ε) and terminal voltage (V) of a cell having internal resistance r. Draw a plot showing the variation of terminal voltage (V) versus the current (I) drawn from the cell. Using this plot, show how does one can determine the internal resistance of the cell?

CBSE All India-2014 C

395. A battery of emf E and internal resistance r when connected across an external resistance of 12Ω, produces a current of 0.5A. When connected across a resistance of 25Ω, it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell.

CBSE All India-2013C

396. A cell of emf E and internal resistance r is connected to two external resistances R_1 and R_2 and a perfect ammeter. The current in the circuit is measured in four different situations:

(i) Without any external resistance in the circuit

(ii) With resistance R_1 only

(iii) With R_1 and R_2 in series combination

(iv) With R_1 and R_2 in parallel combination

The currents measured in the four cases are0.42 A, 1.05A, 1.4 A and 4.2A, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above.

CBSE Delhi-2012

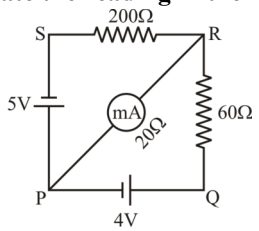
397. A battery of emf 10V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5A, find

(i) the resistance of the resistor

(ii) the terminal voltage of the battery.

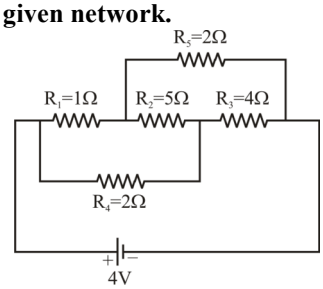
CBSE Delhi-2012C

398. The network PQRS, shown in the circuit diagram, has the batteries of 4V and 5V and negligible internal resistance. A milliammeters of 20Ω resistance is connected between P and R. Calculate the reading in the milliammeter.



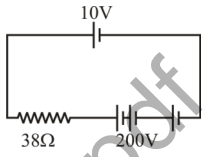
CBSE All India-2012C

399. Calculate the current drawn from the battery in the given network.



CBSE All India-2012C

400. A 10V battery of negligible internal resistance is connected across a 200V battery and a resistance of 38Ω as shown in the figure. Find the value of the current in circuit.



CBSE Delhi-2013

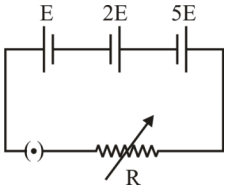
401. The emf of a cell is always greater than its terminal voltage. Why? Given reason.

CBSE Delhi-2013

402. A cell of emf E and internal resistance r draws a current I. Write the relation between terminal voltage V in terms of E, I and r

CBSE Delhi-2013

403. Three cells of emf E, 2E and 5E having internal resistances r, 2r and 3r respectively are connected across a variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R.



CBSE All India-2010C

404. Explain the working of Daniel cell with a neat diagram.

Tamil Nadu Board-2018

405. Explain the determination of the internal resistance of a cell using voltmeter.

Tamil Nadu Board-2011

406. n cells, each of emf e and internal resistance r are joined in the series to form a row. m such rows are connected in parallel to form a battery of N = mn cells. This battery is connected to an external resistance R.

(i) What is the emf of this battery and how much is its internal resistance ?

(ii) Show that current I flowing through the external resistance R is given by

$$I = \frac{Ne}{mR + nr}$$

ISC-2013

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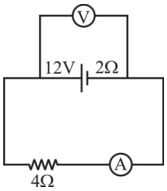
407. Define the emf of a cell in terms of the work done in moving charge through the cell. Using Joule's law obtain the equation, emf = I (R + r). (The symbols have their usual meaning).

ISC-2007

Section-D (Case-Based Questions)

408. A battery of emf 12V and internal resistance 2Ω is connected to a 4Ω resistor as shown in the figure.

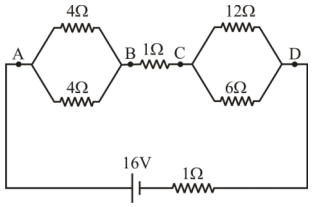


(i) Show that a voltmeter when placed across the cell and across the resistor, in turn, gives the same reading.

(ii) To record the voltage and the current in the circuit, why is voltmeter placed in parallel and ammeter in series in the circuit?

CBSE All India-2016

409. A network of resistors is connected to a 16V battery of internal resistance of 1 Ω as shown in the figure.



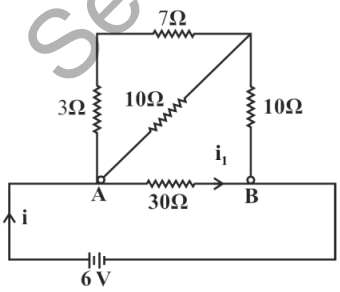
(i) Compute the equivalent resistance of the network

(ii) Obtain the voltage drops V_{AB} and V_{CD}.

CBSE Foreign-2010

410. Find the values of R_{AB} i and i_1 the electrical circuit shown below (assume the internal resistance of their battery and the resistance of the connecting wires to be negligibly small):

Or



Meghalaya Board-2013

411. The resistance and tolerance of a carbon resistor is given as R = 4 × 8 KΩ ± 5%. Write down the sequence of colours on the resistor.

Meghalaya Board-2014

Section-E (Long Answer)

412. Derive an expression for equivalent emf and equivalent resistance of two cells connected in series.

Karnataka Board-July, 2020

413. (a) Draw a graph showing the variation of current versus voltage in an electrolyte when an external resistance is also connected.

(b) (i) The graph between resistance (R) and temperature (T) for Hg is shown in the figure (a). Explain the behaviour of Hg near 4K.

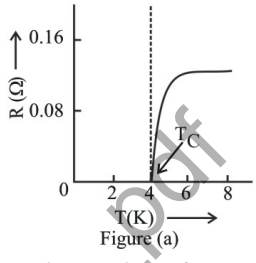


Figure (a)

(ii) In which region of the graph shown in the figure (b) is the resistance negative and why?

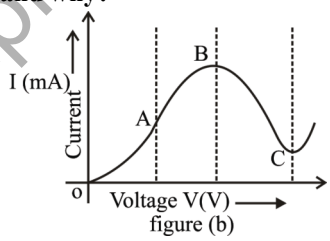


figure (b)

CBSE-2019

414. A cell of e.m.f 1.1 V and an internal resistance of 0.5Ω is connected to a wire of resistance 0.5Ω. Another cell of the same e.m.f is connected in series but the current in the wire remains the same. Find the internal resistance of the second cell.

OR

Two capacitors charged with 4.8×10^{-8} C each are connected in parallel to each other. If the potential difference of one of the capacitors is 12V, calculate the total energy stored in both the capacitors.

Meghalaya Board-2023

415. The circuit diagram of a potentiometer for the determination of internal resistance of a cell is shown below. Calculate the value of the internal resistance (r) of the cell.

Given R = 100Ω, balancing length when key (K)

open = 60 cm. Balancing length when key (K)

Closed = 58 cm.

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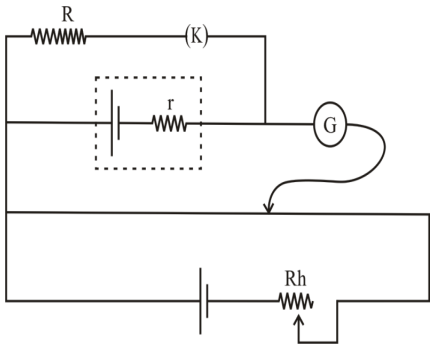

Kerala Board-2013

416. a) Three resistors 3Ω, 4Ω and 12Ω are connected in parallel. What is the effective resistance of the combination?

b) If the combination is connected to a battery of emf 6V and internal resistance 0.5Ω, find the current drawn from the battery and terminal potential difference across the battery.

Karnataka Board-March, 2020

417. Two cells of emf 2V and 4V internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance of 10Ω. Find the potential difference across the 10Ω resistor.

Karnataka Board-March, 2015

418. When two resistors are connected in series with a cell of emf 2V and negligible internal resistance, a current of $\frac{2}{5}$ A flows in the circuit. When the resistors are connected in parallel the main current is $\frac{5}{3}$ A. Calculate the resistance.

Karnataka Board-March, 2017

419. Two identical cells either in series or in parallel combination, gives the same current of 0.5A through external resistance of 4Ω. Find emf and internal resistance of each cell.

Karnataka Board-July, 2015

420. A battery of internal resistance 3Ω is connected to 20Ω resistor and potential difference across the resistor is 10V. If another resistor of 30Ω is connected in series with the first resistor and battery is again connected to the combination. Calculate the emf and terminal potential difference across the combination.

Karnataka Board-March, 2014

421. What is the cause of internal resistance of a cell?

Meghalaya Board-2021

422. Describe the experiment to find internal resistance of a cell by Potentiometer under the following points.

(i) Labelled electric circuit diagram.
(ii) Derivation of formula
(iii) Observation table
(iv) Two precautions

MP Board-2015

423. How cells are combined in parallel? Derive the expression for current flowing in the external circuit. When is this combination useful.

MP Board-2015

424. When the current drawn from a battery is 1.0 A the potential difference between its terminals is 9V. When current drawn from it is 2.0 A the voltage reduces to 6V. Calculate the internal resistance and the emf of the battery.

NIOS-2022

425. (a) Derive a relation between the internal resistance, emf and terminal potential difference of a cell from which current I is drawn. Draw V vs I graph for a cell and explain its significance.

(b) A voltmeter of resistance 998 Ω is connected across a cell of emf 2V and internal resistance 2Ω. Find the potential difference across the voltmeter and also across the terminals of the cell. Estimate the percentage error in the reading of the voltmeter.

CBSE-2019

426. (a) Two cells of different emfs and internal resistances are connected in parallel with one another. Derive the expression for the equivalent emf and equivalent internal resistance of the combination.

(b) Two identical cells of emf 1.5 V and internal resistance r are each connected in parallel providing a supply to an external circuit consisting of two resistances of 17 Ω each joined in parallel. A very high resistance voltmeter reads the terminal voltage of the cell to be 1.4 V. Calculate the internal resistance of each cell.

CBSE-2019

427. Describe briefly, with the help of a circuit diagram, the method of measuring the internal resistance of a cell.

CBSE-2019

428. A battery having an emf of 12 volt and an internal resistance of 2Ω is connected to another battery having and emf of 20 volt and an internal resistance of 2Ω in such a way that they are opposing each other and the circuit is closed. Calculate the following.

(a) Current flowing in the circuit.
(b) Electrical power in the two batteries.
(c) Terminal voltage of the two batteries.
(d) Electrical power consumed in the two batteries.

Gujarat Board- March, 2019

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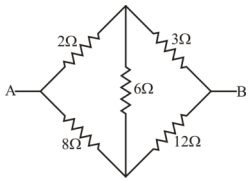
VI. Kirchhoff's Rules

Section-A (Multiple Choice Questions)

429. Five resistors are connected as shown in the figure.



The effective resistance i.e., equivalent between the points A and B is

(a) 4Ω (b) 5Ω
(c) 15Ω (d) 20Ω

ISC-2013

Ans. (a) :

430. The conservation principle consistent with Kirchhoff's voltage law is:

(a) conservation of charge
(b) conservation of energy
(c) conservation of mass
(d) conservation of power

Jharkhand-2023
Gujarat Board-2023
Odisha Board-2022

Ans. (b) :

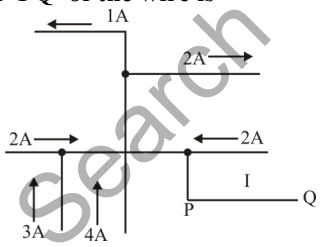
431. The algebraic sum of electric current meeting at a point in open electric circuit will be

(a) zero (b) infinity
(c) positive (d) negative

Bihar Board-2022

Ans. (a) :

432. The figure shows a portion of a circuit. The magnitude and direction of the current 'I' in section 'PQ' of the wire is



(a) 2A from Q to P (b) 4A from P to Q
(c) 6A from Q to P (d) 8A from P to Q

Goa Board-2023

Ans. (d) :

433. Kirchhoff's junction rule represents ——

(a) Conservation of energy
(b) Conservation of linear momentum
(c) Conservation of angular momentum
(d) Conservation of charge

Gujarat Board- March, 2020
Jharkhand-2020

Ans. (d) :

Section-B (Very Short Answer)

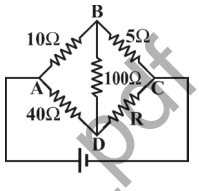
434. State Kirchhoff's voltage law.

MP Board-2022
Meghalaya Board-2018
Haryana Board-2018
J&K Board-2018
Assam Board-2016
Tamil Nadu Board-September, 2016
Tamil Nadu Board-2011

435. Explain Kirchhoff's laws of distribution of currents along with the diagram.

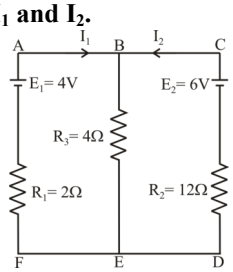
MP Board-2018

436. In the given circuit, no current is flowing through 100Ω resistor. Calculate the value of R, Show relevant mathematical steps.



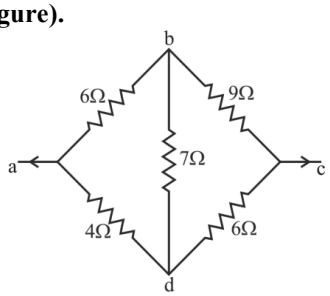
NIOS-2017

437. In the circuit given alongside, E_1 and E_2 are two cells of emfs 4V and 6V respectively, having negligible internal resistance. Applying Kirchhoff's laws of electrical networks, find the values of I_1 and I_2.



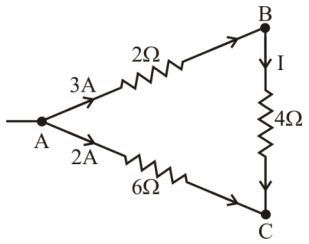
ISC-2008

438. Find the equivalent resistance between the points a and c of the given network of resistors (see figure).



ISC-2000

439. A part of an electric circuit is shown below.



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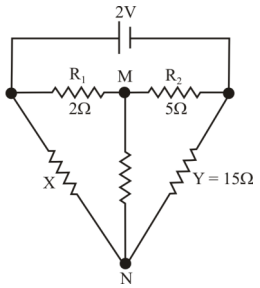
Using Kirchhoff's 2nd law, find the current I flowing through the 4Ω resistor.

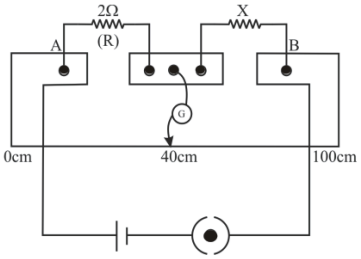
ISC-2010

440. Find the value of resistance X in the circuit below so that the junctions M and N are at the same potential.



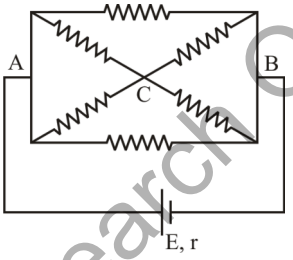
ISC-2009

441. In figure given below, find the value of resistance X for which points A and B are at the same potential.



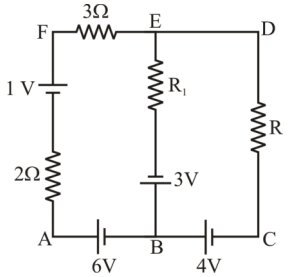
ISC-2016

442. (ii) The current is drawn from a cell of emf E and internal resistance r as shown in the figure. Obtain the expression for
(a) the current drawn from the cell and
(b) the power consumed in the network



CBSE Delhi-2017

443. Use Kirchhoff's rules to determine the potential difference between the points A and D. When no current flows in the arm BE of the electric network shown in the figure below:



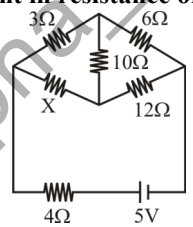
CBSE Delhi-2015

Section-C (Short Answer)

444. State Kirchhoff's laws for an electrical network. Using these laws, deduce the condition for balance in a Wheatstone Bridge.

J&K Board-2023
Meghalaya Board-2023, 2014
Odisha Board-2023
Uttarakhand Board-2023, 2020
Bihar Board-2023, 2021, 2019
Nagaland Board-2021
Karnataka Board-July, 2019, 2016, 2014
Telangana Board-2018
Chhattisgarh Board-2018
Karnataka Board-March, 2017, 2016
ISC-2015, 2012, 2002
Assam Board-2014
Rajasthan Board-2011

445. In adjacent figure, if current is zero in resistance of 10 Ω, then calculate-
(a) Value of resistance X
(b) Current in resistance of 4 Ω

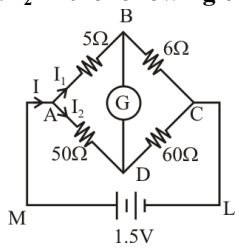


Uttarakhand Board-2022

446. State and explain Kirchhoff's laws.

UP Board-2023, 2019
Assam Board-2023, 2013
Jharkhand Board-2023
Uttarakhand Board-2022
Gujarat Board-March, 2022
Manipur Board-2022
Odisha Board-2022
MP Board-2021, 2012
Meghalaya Board-2021
J&K Board-2019
Karnataka Board-July, 2018
CBSE Delhi-2017
ISC-2017, 2007, 2002
Kerala Board-2013

447. Find I and I_2 in the following circuit :



[Assume negligible internal resistance of the cell]

Meghalaya Board-2017

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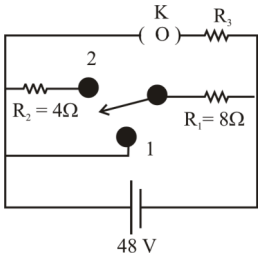
448. In the given circuit diagram the resistance R_1 = 8Ω and R_2 = 4Ω. the circuit is powered by a source of emf E = 48 V

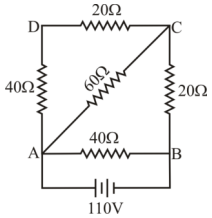


(a) What is the value of the current in the circuit, when the contact 1 is in use and key K is open?

(b) If the contact is moved form 1 to 2 and key K is closed, the total current in the circuit changes by 6A. Calculate R_3 .

Goa Board-2023

449. What is Kirchoff's current law of electric circuit ? In the given figure, calculate the potential difference between A and C.



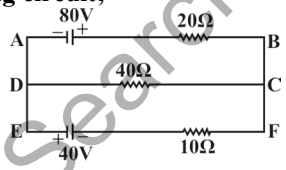
UP Board-2018

450. With the help of Kirchhoff 's laws related with

an electrical circuit, obtain the condition balanced state for wheatstone bridge $\frac{P}{Q}=\frac{R}{S}$. P,Q,R and S are the resistances of the four sides.

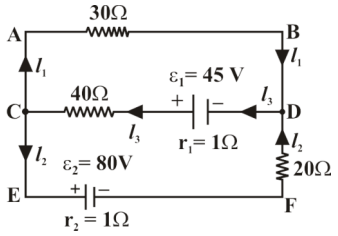
UP Board-2020

451. Using Kirchhoff's rules, calculate the current through the 40 Ω and 20 Ω resistors in the following circuit;



CBSE-2019

452. An electrical network is shown in figure. Applying Kirchoff's rules, determine the values of I_1, I_2 and I_3.



Nagaland Board-2018

453. (i) State Kirchhoff's rules.

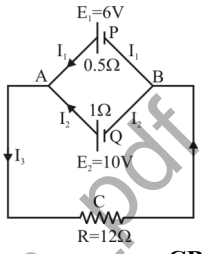
(ii) A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of 1Ω resistance. Use Kirchhoff's rules to determine

(a) the equivalent resistance of the network and

(b) the total current in the network.

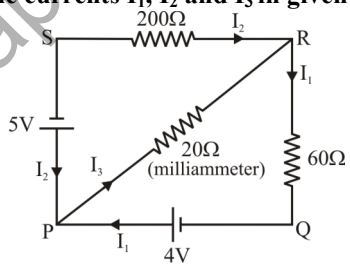
CBSE All India-2010

454. State Kirchhoff's rules. Apply Kirchhoff's rules to the loops ACBPA and ACBQA to write the expression for the currents I_1, I_2 and I_3 in the network



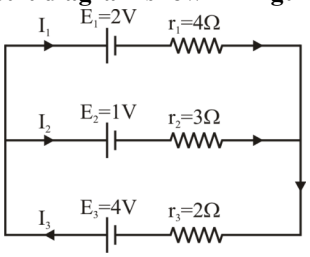
CBSE All India-2010

455. State Kirchhoff's rules. Apply these rules to the loops PRSP and PRQP to write the expressions for the currents I_1, I_2 and I_3 in given circuit.



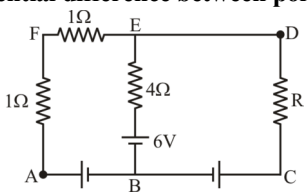
CBSE All India-2010

456. State Kirchhoff's rules. Use these rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown in figure below.



CBSE All India-2010

457. Using Kirchhoff's rules, determine the value of unknown resistance R in the circuit, so that no current flows through 4Ω resistance. Also, find the potential difference between points A and D.



CBSE Delhi-2012

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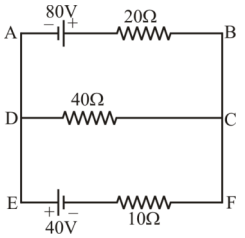
458. Using Kirchhoff's rules, calculate the current through the 40 Ω and 20 Ω resistors in the following circuit.

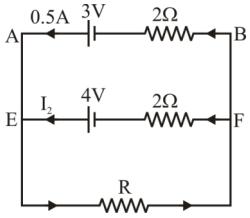


CBSE Delhi-2019

459. Using Kirchhoff's rules in the given circuit, determine

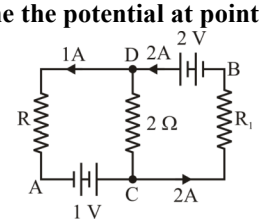
(i) the current I_2 in the arm EF.

(ii) the voltage drop across the unknown resistor R and



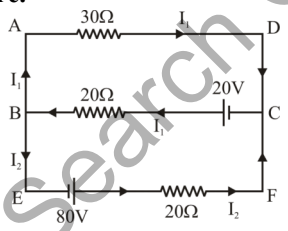
CBSE All India-2011

460. In the given circuit, assuming point A to be at zero potential, use Kirchhoff's rules to determine the potential at point B.



CBSE All India-2011

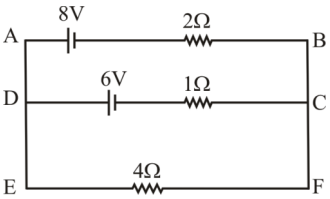
461. Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit shown in the figure.



CBSE Delhi-2013C

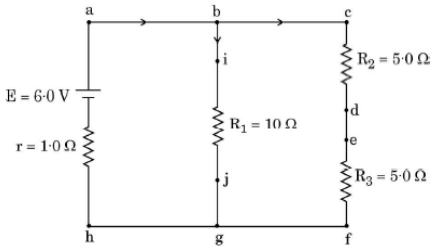
Section-D (Case-Based Questions)

462. Calculate the potential difference across the 4 Ω resistor in the given electrical circuit, using Kirchhoff's rules.



CBSE-2019

463. The following figure shows a circuit diagram. We can find the currents through and potential differences across different resistors using Kirchhoff's rules.



Answer the following questions based on the above :

(a) Which points are at the same potential in the circuit?

(b) What is the current through arm bg ?

(c) Find the potential difference across resistance R_3.

OR

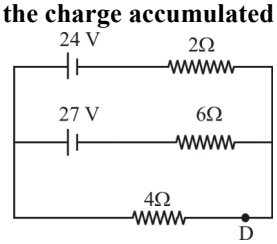
(c) What is the power dissipated in resistance R_2 ?

CBSE-2023

Section-E (Long Answer)

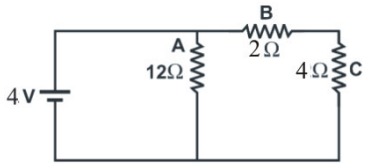
464. Using Kirchhoff's laws determine the current through the resistor 4 Ω in the network shown in the figure.

What is the charge accumulated at point D?



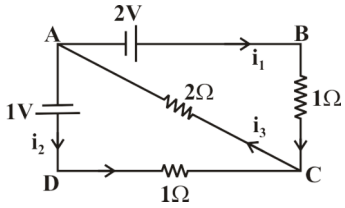
Goa Board-2019

465. State Kirchhoff's rules for electrical network? Calculate the current through each resistor using Kirchhoff's rules.



NIOS-2018

466. Calculate the currents in each branch of the given circuit:



UP Board-2022

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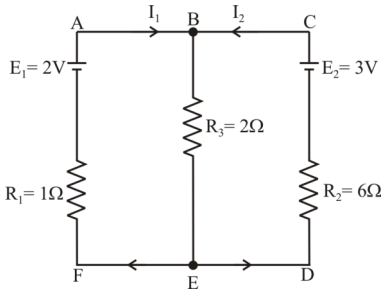
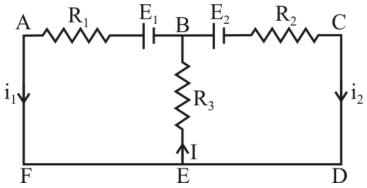
467. (i) In the circuit shown in figure below, E_1 and E_2 are cells having emfs 2V and 3V respectively and negligible internal resistances. Applying Kirchhoff's laws of electrical networks, find the values of currents I_1 and I_2.



(ii) State how a moving coil galvanometer can be converted into an ammeter.

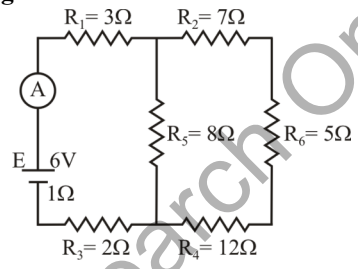
ISC-2016

468. In the circuit shown in figure, E_1 = 17 V, E_2 = 32 V, R_1 = 2Ω, R_2 = 3Ω and R_3 = 5Ω. Using Kirchhoff's laws, find the currents flowing through the resistors R_1, R_2 and R_3 (Internal resistance of each of the batteries is negligible).



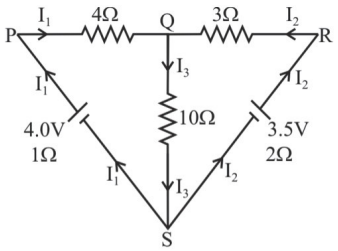
ISC-2013

469. In the circuit shown in figure given alongside, E is a battery of emf 6V and internal resistance 1Ω. Find the reading of the ammeter A, if it has negligible resistance.



ISC-2012

470. In the circuit shown in figure, E_1 and E_2 are batteries having emfs 4.0V and 3.5V respectively and internal resistance 1Ω and 2Ω respectively. Using Kirchhoff's laws, calculate currents I_1, I_2 and I_3.

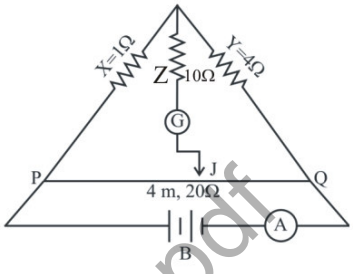


ISC-2011

471. In the circuit shown alongside, PQ is a uniform metallic wire of length 4m and resistance 20Ω. Battery B has an emf of 10 V and internal resistance of 1Ω. J is a jockey or slide contact. Resistance of the ammeter A and connecting wires is negligible.

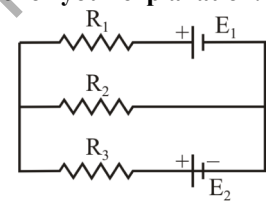
(i) When the jockey J does not touch the wire PQ, what is the reading of ammeter A ?

(ii) Where should the jockey J be pressed on the wire PQ, so that the galvanometer G shows no deflection ?



ISC-2010

472. State and explain Kirchhoff's law for electric circuits. What are the conservation laws implied in each law ? State the sign convention for current and emf. Use the figure given alongside for your explanation.



ISC-2000

VII. Measuring Instrument (Potentiometer, Wheatstone Bridge and Metre Bridge)

Section-A (Multiple Choice Questions)

473. A moving coil galvanometer can be converted into a voltmeter by connecting

(a) a low resistance in series with its coil
(b) a low resistance in parallel with its coil
(c) a high resistance in parallel with its coil
(d) a high resistance in series with its coil

ISC-2010

Ans. (d) :

474. What is mainly measured by potentiometer ?

(a) Current
(b) Resistance
(c) Potential difference
(d) All of these

Bihar Board-2023

Ans. (c) :

Search On TG: @apna_pdf

475. In a Wheatstone bridge, all the four arms have equal resistance R, if the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is

(a) $\frac{R}{4}$ (b) $\frac{R}{2}$

(c) R (d) 2R

Meghalaya Board-2017

Ans. (c) :

476. Sl unit of potential gradient is____.

(a) V cm (b) $\frac{V}{cm}$

(c) V m (d) $\frac{V}{m}$

Maharashtra Board-2018

Ans. (d) :

477. If the length of a potentiometer wire is increased by keeping constant potential difference across the wire, then .....

(a) null point is obtained at larger distance

(b) there is no change in the null point

(c) potential gradient is increased

(d) null point is obtained at shorter distance

Maharashtra Board-2020

Ans. (a) :

478. Which of the following has maximum resistance ?

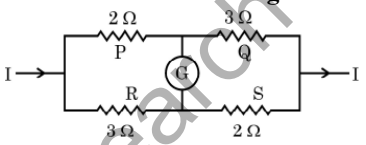
(a) Galvanometer (b) Milliammeter

(c) Ammeter (d) Voltmeter

NIOS-2022

Ans. (d) :

479. Assertion (A) : The given figure does not show a balanced Wheatstone bridge.



Reason (R) : For a balanced bridge small current should flow through the galvanometer.

(a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).

(b) Both Assertion (A) and Reason (R) are true and (R) is not the correct explanation of (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

CBSE-2023

Ans. (c) :

480. A uniform wire of 16Ω resistance is bent round in the form of a circle. When connected in a circuit between its two diametrically opposite points, its effective resistance will be

(a) 8 Ω (b) 16 Ω

(c) 4 Ω (d) 2 Ω

CBSE-2020

Ans. (c) :

481. A potentiometer can measure emf of a cell because

(a) the sensitivity of potentiometer is large.

(b) no current is drawn from the cell at balance.

(c) no current flows in the wire of potentiometer at balance.

(d) internal resistance of cell is neglected.

CBSE-2020

Ans. (b) :

482. The four arms of a Wheatstone bridge have the resistance R_1=100 Ω, R_2=10 Ω, R_3=500 Ω and R_4. What will be the value of R_4 if the wheatstone bridge is balanced?

(a) 5 KΩ (b) 2 Ω

(c) 2 KΩ (d) 50 Ω

Gujarat Board- August, 2020

Ans. (d) :

483. Wheatstone bridge is well known for the determination of _____.

(a) Unknown resistance (b) Unknown emf

(c) Unknown current (d) Potential difference

Gujarat Board- July, 2022

Ans. (a) :

Section-B (Very Short Answer)

484. ..... is a device can be used to measure potential difference, internal resistance of cell and compare emf s of two cells.

Haryana Board-2022

485. Do as directed

What is the condition for potentiometer to be more sensitive ?

J&K Board-2017

486. Write two uses of shunt.

Bihar Board-2021

487. Write two uses of potentiometer.

Bihar Board-2021

488. (b) (i) What is a Wheatstone bridge ? Establish the mathematical form of it.

Assam Board-2023

489. Name the electrical device which is similar to one use of potentiometer. What does the following expression mean?

$$\varepsilon(l) = \phi l$$

Assam Board-2023

490. You are given a potentiometer, a rheostat, one key, a driving cell for potentiometer, one galvanometer, two cells of unknown emf, one two way key and some connecting wires. Using all those given draw a circuit diagram for finding the ratio of the emf of the two cells.

Assam Board-2016

Search On TG: @apna_pdf

491. Distinguish between potentiometer and voltmeter.

Maharashtra Board-2022

492. Define potential gradient of the potentiometer wire.

Maharashtra Board-2022

493. Two resistances X and Y in the two gaps of a meter-bridge gives a null point dividing the wire in the ratio 2 : 3. If each resistance is increased by 30Ω, the null point divides the wire in the ratio 5 : 6, calculate the value of X and Y.

Maharashtra Board-2020

494. A Leclanche cell is balanced on length 280 cm of the potentiometer wire. When a Daniel cell is joined in series with this cell. The balance point is obtained at 480 cm distance. Calculate the e.m.f.s of the two cells.

MP Board-2018

495. Potentiometer is also called an _____voltmeter.

MP Board-2018

496. Write the principle of Wheatstone's bridge and derive the necessary condition for the balance of Wheatstone's bridge.

J&K Board-2022
MP Board-2021, 2019
Karnataka Board-July, 2015
Karnataka Board-March, 2014

497. Write two possible reasons for obtaining deflection on one side in the potentiometer.

Chhattisgarh Board-2023

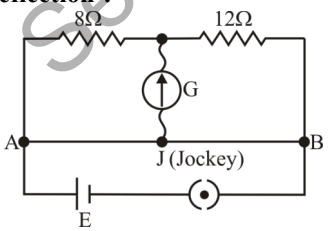
498. The length of the wire of the potentiometer is 10 meters. What will be the value of the voltage gradient when 2 volts electromotive force is applied at its ends?

Chhattisgarh Board-2021

499. Why is a potentiometer preferred over a voltmeter in measuring the emf of a cell ?

ISC-2007

500. In the circuit (given figure below) the length of the wire AB = 400 cm. Where should the jockey J be placed, so that the galvanometer shows a zero deflection ?



ISC-2006

501. A 10m long potentiometer wire carries a steady current. A standard cell of emf 1.018 V is balanced against a length of 254.5 cm of the wire. What is the potential gradient across the potentiometer wire ?

ISC-2011

502. Calculate the electric current density in a uniform wire connected to a battery of emf 3.5 V and negligible internal resistance. The resistance of the wire is 2.0 Ω and its area of cross-section is 0.70×10^{-6} m^2.

ISC-2007

503. (a) Use Kirchhoff's rules to obtain the balance condition in Wheatstone bridge .

(b) Given one practical application that is based on this principle.

CBSE-2019

504. To minimize the percentage error in the determination of unknown resistance of a conductor in meter bridge experiment, the balance point is adjusted near _____ of the wire.

OR

In potentiometer, a long uniform wire is used to _____ potential gradient along the wire.

CBSE-2020

505. Draw the circuit diagram of a meter bridge to explain how it is based on Wheatstone bridge.

CBSE-2020

506. Explain the principle of working of a meter bridge. Draw the circuit diagram for determination of an unknown resistance using it.

MP Board-2022
CBSE-2020

507. Draw the circuit diagram and describe the use of a potentiometer for comparing the emfs of the two primary cells experimentally. Why is potentiometer preferred over a voltmeter for measuring emf of a cell ?

CBSE-2020

508. If 12 resistors each of resistance 12Ω are connected in a cubical network, then determine the equivalent resistance of this network across the diagonally opposite corners of the cube.

Rajasthan Board-2022

509. State the principle of working of a potentiometer using a circuit diagram.

AP Board-2022, 2021
MP Board-2022
UP Board-2022
Kerala Board-2021
J&K Board-2020
CBSE-2020
Jharkhand Board-2020
Haryana Board-2018
Tamil Nadu Board-2016, 2015
CBSE Delhi-2014C

510. Draw the circuit diagram to determine unknown resistance using metrebridge. Write the equation for determining the unknown resistance.

Haryana Board-2018

Search On TG: @apna_pdf

511. Draw the circuit diagram for wheatstone bridge to determine unknown resistance. Write condition for balancing of the bridge.

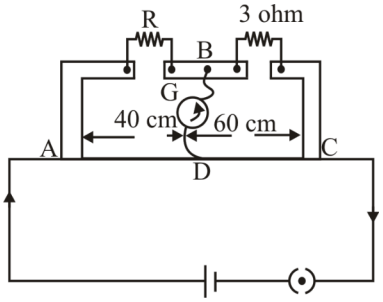
Haryana Board-2018, 2016

512. Derive the expression to find the unknown resistance in the balanced condition of Wheatstone bridge.

Gujarat Board- March, 2019

Section-C (Short Answer)

513. Determine the value of resistance R in the figure, assuming that current through the galvanometer (G) is zero.

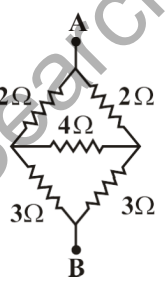


Kerala Board-2021

514. How is a Potentiometer used to compare e.m.f of two cells?

J&K Board-2023, 2021, 2016
Jharkhand Board-2023, 2018
Gujarat Board-2023
Nagaland Board-2021,2018
Kerala Board-2021
Tamil Nadu Board-2017
Assam Board-2015
ISC-2014, 2001
CBSE Delhi-2011
ISC-2002

515. Find the equivalent resistance between point A and B in the given figure



Odisha Board-2020

516. State the working principle of potentiometer Explain with the help of a circuit diagram, how the potentiometer is used to determine the internal resistance of the given primary cell.

A battery of emf 10V and internal resistance 3 Ω is connected to a resistor R. If the current in the circuit is 0.5 A, calculate the value of R.

Telangana Board-2015

517. The four resistor 20Ω, 40Ω, $(20+x)$ Ω, 80Ω respectively form a Wheatstone bridge, find the value of "x".

AP Board-2020

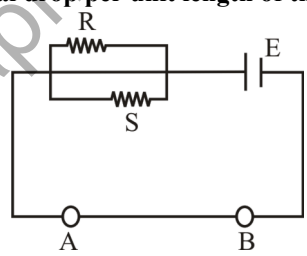
518. In a potentiometer arrangement, the balance point with the cell is 76.3 cm. When a resistor 9.5 Ω is used in the external circuit of the cell the balance point shifts to 64.8 cm. Determine the internal resistance of the cell.

AP Board-2021

519. State the working principle of potentiometer. Explain with the help of a circuit diagram how the emf of two primary cells are compared by using the potentiometer. Find the resistivity of a conductor which carries a current density of 2.5×10^6 Am^{-2} when an electric field of 15 Vm^{-1} is applied across.

AP Board-2023

520. A potentiometer wire AB has a length 0.5m and resistance 0.5Ω. As shown in the diagram, it is connected with a cell of e.m.f 3V and a combination of resistance R = S = 5Ω. Find the potential drop per unit length of the wire.



Assam Board-2017

521. Draw the circuit diagram of a potentiometer to determine the internal resistance of a cell and briefly describe the procedure.

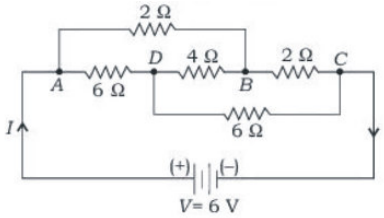
Assam Board-2015

522. How is the critical frequency related to electron density in the ionosphere?

Assam Board-2015

523. (a) Why do we prefer potentiometer to compare the e.m.f.s of cells than a voltmeter ?

(b) Find I in the following circuit.



Meghalaya Board-2019

524. The circuit shown in the figure below contains a battery B, a rheostat Rh and identical lamps P and Q. What will happen to the brightness of the lamps if the resistance through the rheostat is increased? Give reasons.

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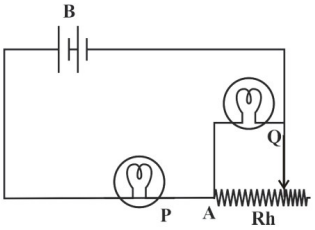


Meghalaya Board-2018

525. When a resistor of 5Ω is connected across the cell, its terminal potential difference is balanced by 150 cm of potentiometer wire and when a resistance of 10Ω is connected across the cell, the terminal potential difference is balanced by 175 cm of the same potentiometer wire. Find the balancing length when the cell is in open circuit and the internal resistance of the cell.

Maharashtra Board-2019

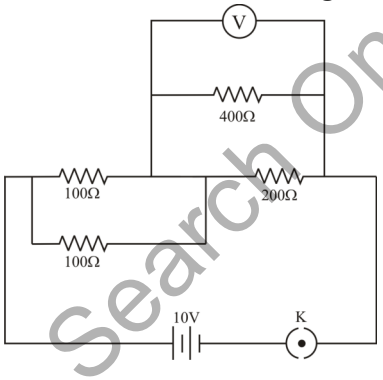
526. Describe an experiment to determine the resistance of a wire by meter bridge on the following points.
(i) Circuit diagram
(ii) Derivation of formula

Chhattisgarh Board-2022

527. Explain the experiment to determine the unknown resistance of a wire using metre bridge under the following points :
(i) Circuit diagram
(ii) Principle
(iii) Precautions (any two)

Chhattisgarh Board-2018

528. Given that the resistance of the voltmeter is 400Ω. Find the voltmeter reading.



ISC-2004

529. You are provided one low resistance R_L and one high resistance R_H and two galvanometer. One galvanometer is to be converted to an ammeter and the other to a voltmeter. Show how you will do this with the help of simple, labelled diagrams.

ISC-2013

530. A galvanometer with a resistance of 75 Ω produces a full scale deflection with current of 5 mA. How can this galvanometer be converted into an ammeter which has a range of 0-5 A ?

ISC-2011

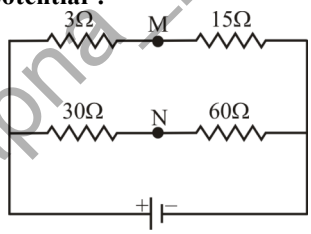
531. The resistance of a galvanometer is 50Ω. It is converted into
(i) a voltmeter using a 10 kΩ resistor.
(ii) an ammeter using a 10 mΩ resistor.
Calculate the resistance of the voltmeter and the ammeter to an accuracy of 2 significant figures only.

ISC-2002

532. A 10m long uniform metallic wire having a resistance of 20Ω is used as potentiometer wire. This wire is connected in series with another resistance of 480Ω and a battery of emf 5V having negligible internal resistance. If an unknown emf e is balanced across 6m of the potentiometer wire, calculate
(i) the potential gradient across the potentiometer wire.
(ii) the value of the unknown emf e.

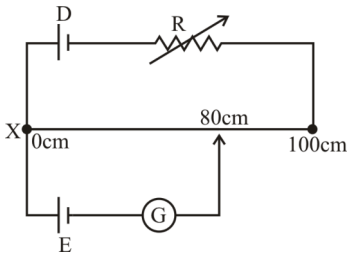
ISC-2015

533. How much resistance should be connected to 15Ω resistor shown in the circuit in figure below, so that the point M and N are at the same potential ?



ISC-2013

534. The figure alongside shows a uniform maganin wire XY of length 100 cm and resistance 9Ω, connected to an accumulator D of emf 4 V and internal resistance 1Ω through a variable resistance R. E is a cell of emf 1.8V connected to the wire XY via jockey J and a galvanometer G. It found that the galvanometer shows no deflection when X J = 80 cm. Find the value of R.



ISC-2009

535. A galvanometer with a coil of resistance 100Ω and a scale having 100 divisions has a current sensitivity of 25 μA/ division. How will you convert it into an ammeter of range 0 to 5A?

ISC-2008

536. For the circuit shown in the figure, how would the balancing length be affected, if
(i) R_1 is decreased
(ii) R_2 is increased,
The other factors remaining the same in the circuit. Justify your answer in each case.

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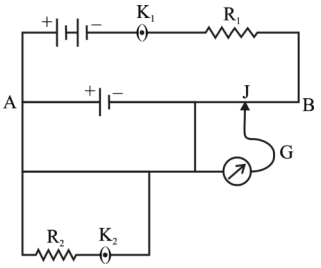
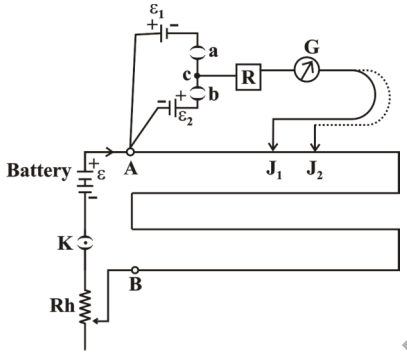


(b) Why is a potentiometer preferred over a voltmeter? Give reason.

CBSE-2019

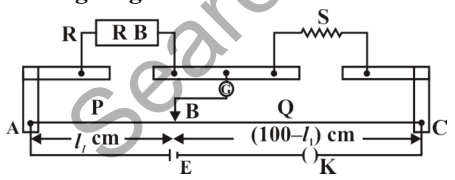
537. A student used the circuit diagram of a potentiometer as shown in the figure (a) For a steady current I passing through the potentiometer wire, he gets a null point for the cell ε_1 and not for ε_2. Give reason for this observation and suggest how this difficulty can be resolved. (b) What is the function of resistance R used in the circuit ? How will change in its value affect the null point ?

(c) How can the sensitivity of the potentiometer be increased ?



CBSE-2019

538. What is end error in a metre bridge? How is it overcome? The resistances in the two arms of the metre bridge are R = 5 Ω and S respectively. When the resistance S is shunted with an equal resistance, the new balance length found to be 1.5 l_1 where l_1 is the initial balancing length. Calculate the value of S.



CBSE-2019

539. In a potentiometer, a standard source of emf 5V and negligible internal resistance maintains a steady current through the potentiometer wire of length 10m. Two primary cells of emf E_1 and E_2 are joined together in a series with (i) same polarity and (ii) opposite polarity. The combination is connected to the potentiometer circuit in each case. The balancing length of the wire in the two cases are found to be 700 cm and 100 cm, respectively.

Find the values of emf of the two cells.

CBSE-2020

540. State the principle of working of Wheatstone bridge. With the help of a circuit diagram, explain how it is used in the determination of the specific resistance of the material of a wire using meter bridge.

CBSE-2020

541. Drawing a labelled circuit diagram of Wheatstone bridge, derive condition for zero deflection in the bridge.

Rajasthan Board-2023

542. With a help of circuit diagram, obtain an expression for unknown resistance of a metallic conductor using a meter bridge.

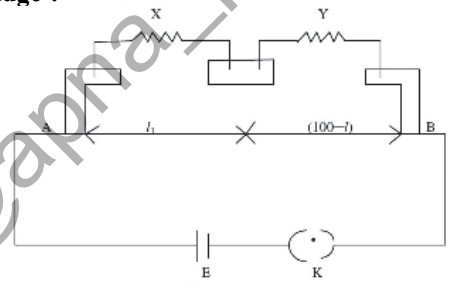
Nagaland Board-2017

543. (a) In a meter bridge, the balance point is found to be at 39.5 cm from A. When the resistor Y is of 12.5 Ω.

(i) Determine the resistance of X.

(ii) Determine balance point of the bridge above, if X and Y are interchanged.

(iii) What happens if the galvanometer and cell are interchanged at the balance point of the bridge ?



OR

(b) Three resistors 1Ω, 2Ω, 3Ω are combined in series .

(i) What is the total resistance of the combination ?

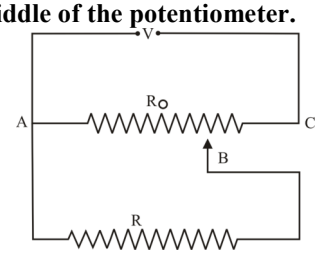
(ii) If the combination is connected to a battery of emf 12V and negligible internal resistance, obtain the potential drop across the resistor.

Nagaland Board-2020

544. Explain the use of meterbridge for finding an unknown resistance.

Haryana Board-2017

545. A resistance of R Ω draws current from a potentiometer. The potentiometer has a total resistance R_0 Ω. A voltage V is supplied to the potentiometer. Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer.



Gujarat Board- August, 2020

546. Two heating elements of resistances R_1 and R_2 when operated at a constant supply of voltage

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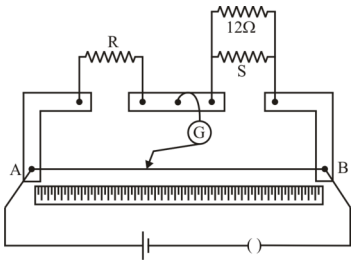
V, consume powers P_1 and P_2, respectively. Deduce the expressions for the power of their combination when they are in turn, connected in
(i) Series and
(ii) parallel across their same voltage supply.

CBSE All India-2011

547. In a meter bridge, the null point is found at a distance of 40 cm from A. If a resistance of 12Ω is connected in parallel with S, then null point occurs at 50.0 cm from A. Determine the values of R and S.

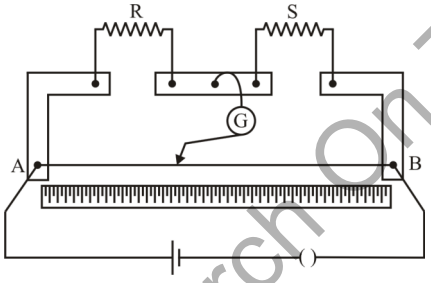


CBSE Delhi-2010

548. Draw the circuit diagram of a potentiometer which can be used to determine the internal resistance r of a given cell of emf E and explain it. How can we increase the sensitivity of a potentiometer?

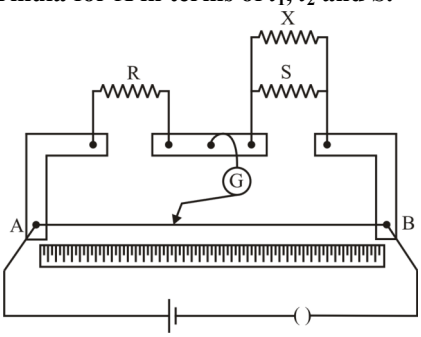
CBSE Delhi-2010

549. In a meter bridge, the null point is found at a distance of 60 cm from A. If a resistance of 5Ω is connected in series with S, then null point occurs at 50.0 cm from A. Determine the value of R and S.



CBSE Delhi-2010

550. In a meter bridge, the null point is found at a distance of l_1 cm from A. If a resistance of X is connected in parallel with S, then null point occurs at a distance l_2 cm from A. Obtain the formula for X in terms of l_1, l_2 and S.



CBSE Delhi-2010

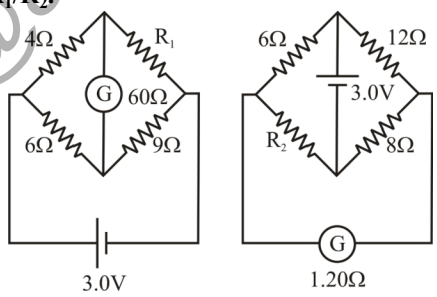
551. Answer the following:
(i) Why are the connections between the resistor in a meterbridge made of thick copper stripes?
(ii) Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire?
(iii) Which material is used for the meter bridge wire and why?

CBSE All India-2014

552. In the figure, a long uniform potentiometer wire AB is having a constant potential gradient along its length. The null points for the two primary cells of emfs E_1 and E_2 connected in the manner shown, are obtained at a distance of 120 cm and 300 cm from the end A.
Find
(i) E_1/E_2 and
(ii) position of null point for the cell E_1.
How is the sensitivity of a potentiometer increased?

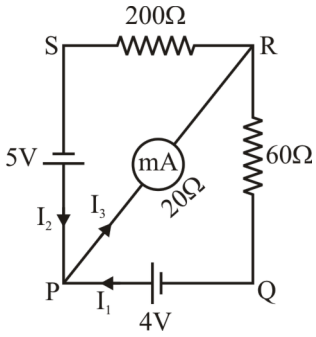
CBSE Foreign-2014, CBSE Delhi-2012

553. Define the current sensitivity of a galvanometer. Write its SI unit.
Figure shows two circuits each having a galvanometer and a battery of 3V.
When the galvanometer in each arrangement do not show any deflection, obtain the ratio R_1/R_2.



CBSE All India-2013

554. State the underlying principle of a potentiometer. Write two factors on which the sensitivity of a potentiometer depends. In the potentiometer circuit shown in the figure, the balance point is at X. State, giving reason, how the balance point is shifted when



(i) resistance R is increased
(ii) resistance S is increased, keeping R constant?

CBSE All India-2013C

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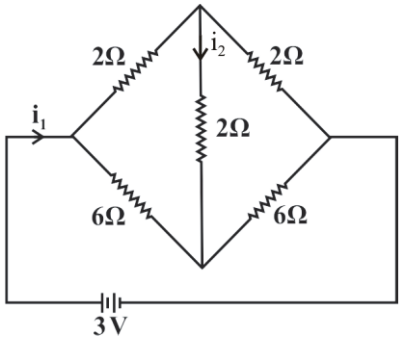
Section-D (Case-Based Questions)

555. Explain, with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of a cell?

Meghalaya Board-2015, 2013

556. Find i_1 and i_2 in the following circuit:



Meghalaya Board-2013

Section-E (Long Answer)

557. Write the principle of potentiometer. How the emfs of two cells are compared with the help of potentiometer? Explain with circuit diagram.

Uttarakhand Board-2020

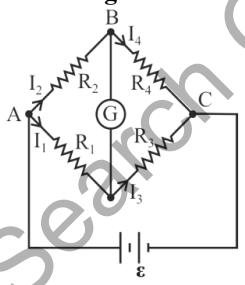
558. Describe the construction and working of potentiometer. How is the electromotive force of two cells compared by this? Explain with the help of circuit diagram.

Uttarakhand Board-2023

559. Write the principle of meter bridge. Draw the circuit diagram of meter bridge to calculate the resistance of a wire and with its help derive the formula to find the resistance of wire. 5

Uttarakhand Board-2019

560. A Wheatstone bridge is shown in figure.

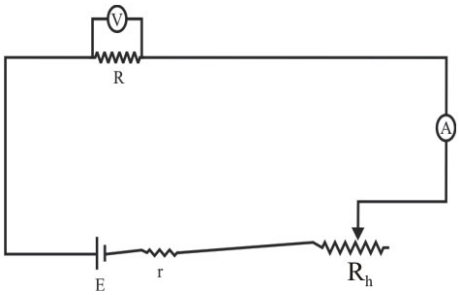


(a) Derive a relation connecting the four resistors for the galvanometer to give zero or null deflection.

(b) Name a practical device which uses this principle.

Kerala Board-2020

561. A resistance R is connected to a cell of emf E and has an internal resistance r as shown in the figure. The voltage across R is measured using and ideal voltmeter and circuit current is measured by an ammeter. A rheostat of negligible resistance is used to vary the current in the circuit.



(a) Write down the expression for current in the circuit and voltage across R at any instant.

(b) Draw a graph connecting current in the circuit along X-axis and voltage across R along Y-axis.

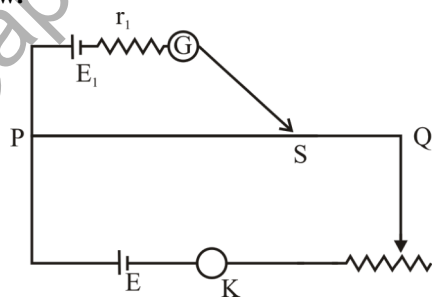
(c) The quantity obtained from the slope of the graph is_____.

Kerala Board-2017

562. Why is a slide wire bridge also called meter bridge ?

Meghalaya Board-2021

563. In a potentiometer experiment, PS is the balancing length obtained for a cell of e.m.f E_1 and internal resistance r_1 as shown in the figure below.



How does the balancing length change , if

(a) The length of the potentiometer wire is doubled?

(b) An external resistance R of finite value is connected in series with the potentiometer wire

(c) Another identical cell is connected in parallel with E_1 with their positive terminals together

Goa Board-2018

564. Describe the experiment to compare the e.m.f. of two cells using potentiometer under the following points:

(a) Labelled electric circuit diagram

(b) Derivation of formula

(c) Observation table

(d) Two precautions

MP Board-2014, 2015

565. Name two merits of Wheatstone bridge method for the measurement of low resistances. Using Kirchhoff's law, calculate the current shown by milliammeter of 20Ω resistance.

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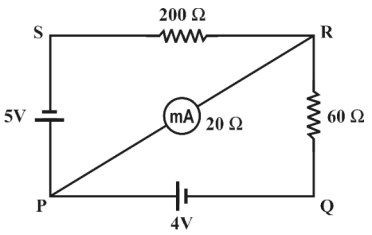
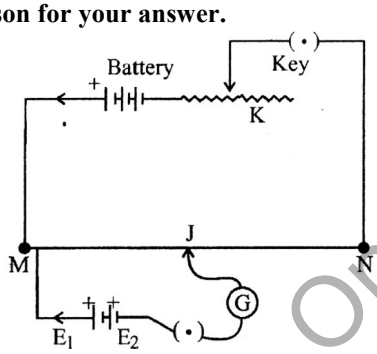


NIOS-2015

566. (a) State the principle of which working of a potentiometer is based.

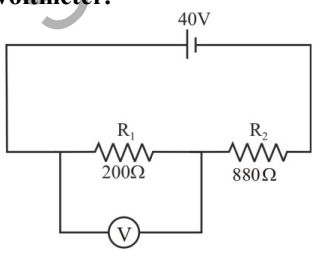
(b) Which is better for comparing the e.m.fs of two primary cells, a voltmeter or potentiometer and why?

(c) A student wanting to compare the e.m.fs of two cells E_1 and E_2, connects them to a potentiometer circuit as shown here (i.e. he connects the negative terminal of E_2 to the positive terminal of E_1) and finds the balancing length of the potentiometer wire to be l_1. He next reverses the terminals of the cell E_2 and connects negative terminal of E_2 to the negative terminal of E_1. He now obtains balance point for a length l_2. Explain whether the student will be able to find the ratio $\frac{E_1}{E_2}$ or not. Explain the reason for your answer.



NIOS-2016

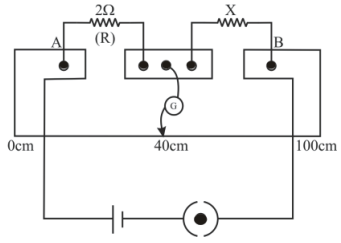
567. (i) Figure below shown two resistors R_1 and R_2 connected to a battery having an emf of 40V and negligible internal resistance A voltmeter having a resistance of 300Ω is used to measure potential difference across R_1. Find the reading of the voltmeter.



(ii) A moving coil galvanometer has a coil of resistance 59Ω. It shows a full scale deflection for a current of 50 mA. How will you convert it to an ammeter having a range of 0 to 3A ?

ISC-2017

568. In a meter bridge circuit, resistance in the left hand gap is 2Ω and an unknown resistance X is in the right hand gap as shown in figure below. The null point is found to be 40cm from the left end of the wire. What resistance should be connected to X so that the new null point is 50cm from the left end of the wire ?



ISC-2017

569. Draw a labelled circuit diagram of a potentiometer to measure internal resistance of a cell. Write the working formula. (Derivation not required).

ISC-2016

570. (a) State the working principle of a meter bridge used to measure an unknown resistance.

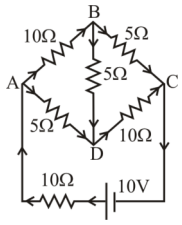
(b) Give reason

(i) why the connections between the resistors in a metre bridge are made of thick copper strips.

(ii) why is it generally preferred to obtain the balance length near the mid-point of the bridge wire.

CBSE-2019

571. Determine the current in each branch of the given network.



Gujarat Board- March, 2020

572. Obtain the principle of the Wheatstone's bridge. Explain the use of meter bridge which is prepared using this principle.

Gujarat Board- July, 2022

573. (i) State the working principle of a potentiometer. Draw a circuit diagram to compare emf of two primary cells. Derive the formula used.

(ii) Which material is used for potentiometer wire and why?

(iii) How can the sensitivity of a potentiometer be increased?

CBSE Delhi-2011

574. (i) State with the help of a circuit diagram, the working principle of a meter bridge. Obtain the expression used for determining the unknown resistance.

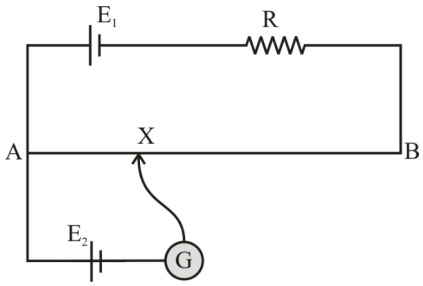
(ii) What happens if the galvanometer and cell are interchanged at the balance point of the bridge?

Search On TG: @apna_pdf

(iii) Why is it considered important to obtain the balance point near the mid-point of the wire?

CBSE Delhi-2011C

575. In the circuit diagram given below AB is a uniform wire of resistance 15Ω and length 1m is connected to a cell E_1 of emf 2V and negligible internal resistance and a resistance R.



(i) The balance point with another cell E_2 of emf 75 mV is found at 30cm from end A. calculate the value of R.

(ii) Why is potentiometer preferred over a voltmeter for comparison of emf of cells?

(iii) Draw a circuit diagram to determine internal resistance of a cell in the laboratory.

CBSE Foreign-2015

576. (i) State the working principle of potentiometer. With the help of the circuit diagram, explain how a potentiometer is used to compare the emf's of two primary cells. Obtain the require expression used for comparing the emfs.

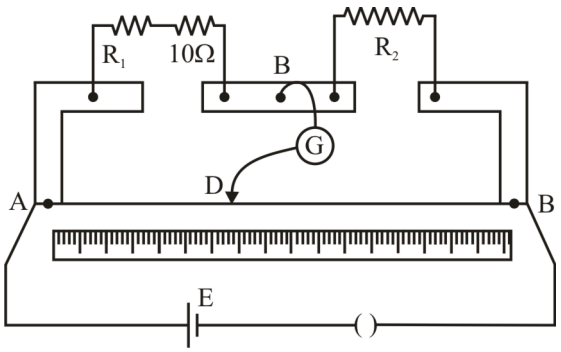
(ii) Write two possible causes for one sided deflection in a potentiometer experiment.

CBSE Delhi-2013

577. (i) State Kirchhoff's rules for an electric network. Using Kirchhoff's rules, obtain the balance condition in terms of the resistances of four arms of Wheatstone bridge.

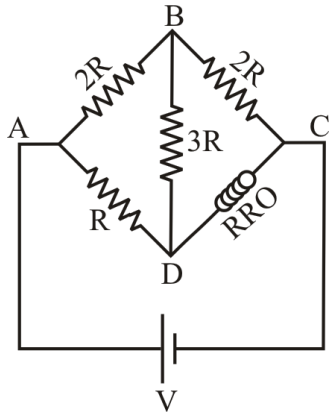
(ii) In the meter bridge experimental set up, shown in the figure, the null point D is obtained at a distance of 40 cm from end A of the meter bridge wire.

If a resistance of 10Ω is connected in series with R_1, null point is obtained at AD = 60 cm. Calculate the values of R_1 and R_2.



CBSE Delhi-2013

578. (i) Use Kirchhoff's rules to obtain the balance condition in a Wheatstone bridge.



(ii) Calculate the value of R in the balance condition of the Wheatstone bridge, if the carbon resistor connected across the arm CD has the colour sequence red, red and orange, as shown in the figure.

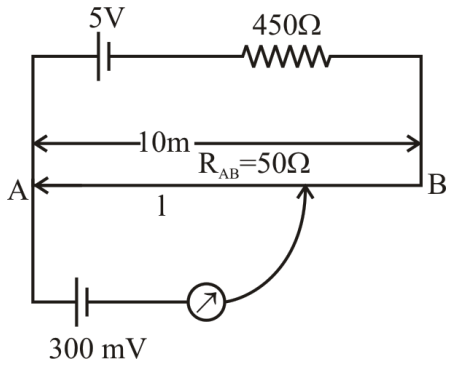
(iii) If now the resistance of the arms BC and CD are interchanged, to obtain the balance condition, another carbon resistor is connected in place or R. What would now be sequence of colour bands of the carbon resistor?

CBSE Delhi-2012

579. (a) Describe briefly, with the help of a circuit diagram, the method of measuring the internal resistance of a cell.

(b) Give reason why a potentiometer is preferred over a voltmeter for the measurement of emf of a cell.

(c) In the potentiometer circuit given below, calculate the balancing length *l*. Give reason, whether the circuit will work, if the driver cell of emf 5 V is replaced with a cell of 2V, keeping all other factors constant.



CBSE-2019

CBSE Delhi-2010

580. How the emf of two cells are compared using potentiometer?

Tamil Nadu Board-2023

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04. Moving Charges and Magnetism

I. Magnetic Force

Section-A (Multiple Choice Questions)

1. A proton and an α particle are projected with the same velocity normal to a uniform magnetic field. The ratio of the magnetic Lorentz force experienced by the proton and the α particle is:

(a) 1:1 (b) 1:2
(c) 2:1 (d) 1:0

Tamil Nadu Board-2015

Ans. (b) : j

2. A wire of length *l* carrying a current I along the Y direction is kept in a magnetic field given by $\vec{B} = \frac{\beta}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)T$. The magnitude of Lorentz force acting on the wire is :

(a) $\sqrt{2}\beta Il$ (b) $\sqrt{\frac{2}{3}}\beta Il$
(c) $\sqrt{\frac{1}{2}}\beta Il$ (d) $\sqrt{\frac{1}{3}}\beta Il$

Tamil Nadu Board-2022

Ans. (b) : j

(v). A moving charge can produce-

(a) Only electric field
(b) Only magnetic field
(c) Both electric & magnetic field
(d) None of these

Rajasthan Board-2022

Ans. (c) : j

3. A strong magnetic field is applied on a stationary electron. Then the electron

(a) moves in the direction of the field
(b) remain stationary
(c) moves perpendicular to the direction of the field
(d) moves opposite to the direction of the field

Nagaland Board-2020

Ans. (b) :

4. Which one of the following is correct form of Lorentz force?

(a) $\vec{F} = q\left[\vec{E} + \left(\vec{B}\times\vec{v}\right)\right]$
(b) $\vec{F} = q\left[\vec{E} - \left(\vec{B}\times\vec{v}\right)\right]$
(c) $\vec{F} = q\left[\vec{E} - \left(\vec{v}\times\vec{B}\right)\right]$
(d) None of the given choices

Gujarat Board- July, 2022
Gujarat Board-August, 2020

Ans. (a) : j

5. A charge particle after being accelerated through a potential difference 'V' enters in a uniform magnetic field and moves in a circle of radius r. If V is doubled, the radius of the circle will become

(a) 2r (b) $\sqrt{2}$ r
(c) 4r (d) $r/\sqrt{2}$

CBSE-2020

Ans. (b) : j

6. A charged particle is projected along the magnetic field line. Magnetic force on the particle is

(a) perpendicular to the velocity only
(b) perpendicular to the magnetic field only
(c) perpendicular to both the velocity and magnetic field
(d) zero

Meghalaya Board-2021

Ans. (d) : j

7. The force acting on a moving charge in a magnetic field is

(a) parallel to velocity $\vec{V}$
(b) Perpendicular to magnetic field $\vec{B}$ only
(c) perpendicular to $\vec{V}$ and $\vec{B}$
(d) perpendicular to $\vec{V}$ and parallel to $\vec{B}$

Meghalaya Board-2015

Ans. (c) : j

Section-B (Very Short Answer)

8. Define one ampere of current in terms of the force between two infinitely long parallel current carrying conductors.

Meghalaya Board-2013

9 The direction of magnetic field is one, along which a moving charge expenses no magnetic force. (True/False)

J&K Board-2017

10. The force acting on a charge moving through a uniform magnetic field is maximum when…….. (Fill in the blanks)

J&K Board-2012

11. An electron revolves with an orbital velocity v in an orbit of radius r.
Derive the formula for its magnetic moment.

Rajasthan Board-2011

12. The force acting on a charge particle moving inside magnetic field is known as? Write its expression.

MP Board-2021
J&K Board-2012

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13. The speed of a charged particle moving in a magnetic field does not change. Why?

MP Board-2021

14. Why magnetic lines of force do not intersect each other?

Chhattisgarh Board-2018

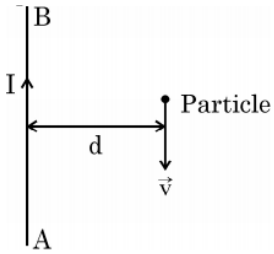
15. Obtain the conditions under which an electron does not suffer any deflection while passing through a magnetic field.

CBSE-2019

16. Write the expression for the Lorentz force on a particle of charge q moving with a velocity $\vec{v}$ in a magnetic field $\vec{B}$. When is the magnitude of this force maximum? Show that no work is done by this force on the particle during its motion from a point $\vec{r}_1$ to point $\vec{r}_2$.

OR

A long straight wire AB carries a current I. A particle (mass m and charge q) moves with a velocity $\vec{v}$, parallel to the wire, at a distance d from it as shown in the figure. Obtain the expression for the force experienced by the particle and mention its directions.



CBSE-2023

17. An alpha particle is projected with velocity $\vec{v} = (3{\cdot}0 \times 10^5$ m/s) $\hat{i}$ into a region in which magnetic field $\vec{B} = [(0{\cdot}4\ T)\hat{i} + (0{\cdot}3\ T)\hat{j}]$ exists. Calculate the acceleration of the particle in the region. $\hat{i}, \hat{j}$ and $\hat{k}$ are unit vectors along x, y and z axis respectively and charge to mass ratio for alpha particle is $4{\cdot}8\ 10^7$ C/kg.

CBSE-2023

18. (ii) Match the following and rewrite.

(1) $\vec{F}$	(a) = qvB sinθ
(2) F	(b) = mv/ qB
(3) r	(c) $= \frac{\mu_0}{4\pi}\frac{Id\vec{l}\times\vec{r}}{r^3}$
(4) $d\vec{B}$	(d) = $q[\vec{E}(\vec{r})+\vec{v}\times\vec{B}(\vec{r})]$

Assam Board-2023

19. A uniform magnetic field of 2T is produced in a Cylindrical region of free space having radius 5cm. A conductor carrying a current 500mA passes through the region intersecting the axis normally. What is the magnitude of the force acting on the conductor?

Assam Board-2017

20. A circular coil of closely wound N turns and radius r carries a current I. Write the expressions for the following:
(i) The magnetic field at its centre.
(ii) The magnetic moment of this coil.

CBSE All India-2012

21. The relation between weber and tesla is——

Odisha Board-2023

22. Write the expression for magnetic potential energy of a magnetic dipole kept in a uniform magnetic field and explains the terms.

Karnataka Board-July, 2018

23. Write the expression for force experienced by a straight conductor of length $\vec{l}$ carrying a steady current I, moving in a uniform external magnetic field $\vec{B}$.

Karnataka Board-July, 2018

24. Write any two properties of magnetic field lines.

Haryana Board-2016
Karnataka Board-July, 2014

25. What is Lorentz force?

Bihar Board-2019, 2021, 2022
MP Board-2022
Assam Board-2013

26. Write Fleming's left hand rule.

Bihar Board-2022

Section-C (Short Answer)

27. Write the expression for the Lorentz force F in vector form.

ISC-2016

28. Derive an expression for the force on a current carrying conductor placed in a magnetic field. Find the magnitude of the force.

Tamil Nadu Board-September, 2016

29. List out salient features of magnetic Lorentz force.

Tamil Nadu Board-2022

30. Using the concept of force between two infinitely long parallel current carrying conductors define one ampere of current.

CBSE All India-2014

31. Determine the dimension of magnetic permeability μ_0.

Odisha Board-2020

Section-D (Long Answer)

32. Derive an expression for the force acting on a current carrying straight conductor kept in a uniform magnetic field. Name the rule used to determine the direction of this force. Under what condition this force is maximum and zero?

Punjab Board-2018

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33. Show that a planer loop carrying a current I, having N closely wound turns and area of cross-section A, possesses a magnetic moment
m = NIA.

CBSE Foreign-2011

34. Deduce an expression for the force on a current carrying conductor placed in a magnetic field.

Gujarat Board- May, 2021
Nagaland Board-2020
Tamil Nadu Board-2018

35. Write the expression for Lorentz magnetic force on a particle of charge q moving with velocity v in a magnetic field B. Show that no work is done by this force on the charged particle.

CBSE All India-2011

36. Two rings X and Y are placed in such a way that their axes are along the X and Y axes respectively and their centre are at the origin. Both the rings X and Y have the same radii of 3.14 cm. If the current through X and Y rings are 0.3A and 0.4A respectively then find the value of the resultant magnetic field at the origin. $\mu_0 = 4\pi \times 10^{-7}$ SI.

Gujarat Board- March, 2019

37. What is Lorentz force ? Two current carrying conductors of length *l* and 4*l* are bent to form coils of turns 2 and 4 respectively. If the same current is passed through both coils, then find the ratio of intensity of magnetic field at their centres.

UP Board-2018

38. (a) Find an expression for the force per unit length between two parallel wires carrying current in the same direction. Hence, define ampere.

Meghalaya Board-2023

II. Motion in Magnetic Field

Section-A (Multiple Choice Questions)

39. In a Cyclotron, a charged particle
(a) speeds up in a dee.
(b) speeds up between the dees because of magnetic field .
(c) undergoes acceleration all the time.
(d) shows down within a dee and speeds up between dees.

Gujarat Board-2023

40. Van de Graaff generator is an electrostatic machine which produces
(a) Only high current
(b) Only high voltage
(c) High current and high voltage
(d) Low current and low voltage

Bihar Board-2023

41. Frequency of cyclotron is independent of ——.
(a) Charge of a particle
(b) Radius of its trajectory
(c) applied magnetic field
(d) Mass of a particle

Gujarat Board- March, 2020

42. There are uniform electric and magnetic fields in a region pointing along X-axis. An α-particle is projected along Y-axis with a velocity v. The shape of the trajectory will be
(a) circular in XZ plane
(b) circular in YZ plane
(c) helical with its axis parallel to X-axis
(d) helical with its axis parallel to Y-axis

CBSE-2020

43. A beam of cathode rays moves from left to right in a plane of the paper and it enters into a uniform magnetic field acting perpendicular to the plane of the paper and inwards. Now, the cathode rays are deflected.
(a) downwards
(b) upwards
(c) in a direction perpendicular to the plane of the paper and inwards
(d) in a direction perpendicular to the plane of the paper and outwards

Tamil Nadu Board-March, 2016

44. When a charged particle moves in a uniform magnetic field its kinetic energy___.
(a) can increase
(b) remains constant
(c) can decrease
(d) can increase or decrease

Gujarat Board- March, 2019

45. At a place a uniform electric field and a uniform magnetic field are in the upward direction. There an electron moves in the downward direction. Hence this electron____.
(a) will bend towards right
(b) will bend towards left
(c) will gain velocity
(d) will lose velocity

Gujarat Board- March, 2019

46. The place where the horizontal and vertical components of earth's magnetic field become equal the angle of dip becomes _____.
(a) 0º (b) 45º
(c) 90º (d) 60º

Gujarat Board- July, 2022

47. Which of the following is not correct about the magnetic field lines?
(a) The magnetic field lines of a magnet from continuous closed loops
(b) The tangent to the field lines at a given point represents the direction of the net magnetic field at that point

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(c) The larger the number of field lines crossing per unit area, the stronger is the magnitude of the magnetic field B
(d) The magnetic field lines may intersect each other in certain conditions

Jharkhand Board-2023

48. Two particles of masses m_1 and m_2 have equal charges. They are accelerated from rest through a potential difference V and then enter in a region of uniform magnetic field $\vec{B}$. If they describe circular paths of radii r_1 and r_2, respectively, then the value of m_1/m_2 is

(a) $\left(\frac{r_2}{r_1}\right)^2$ (b) $\frac{r_1 V}{r_2 B}$

(c) $\left(\frac{r_1}{r_2}\right)^2$ (d) $\frac{r_1^2 V}{r_2^2 B}$

CBSE-2020

49. When a charged particle enters a magnetic field at an angle of 60° with the field direction it traces

(a) a circular path (b) a parabolic path
(c) a helical path (d) a hyperbolic path

Goa Board-2018

50. When any moving charge enters in a magnetic field perpendicularly then its path will be:

(a) Parabolic (b) Circular
(c) Straight line (d) Elliptical

Haryana Board-2022
Uttarakhand Board-2019

51. Which of the following rays is not deflected by magnetic field ?

(a) alpha rays (b) beta rays
(c) gamma rays (d) positive rays

Bihar Board-2022

Section-B (Very Short Answer)

52. How does cyclotron increase the energy of charged particles ?

Nagaland Board-2020

53. Write the dimensional formula of magnetic field.

J&K Board-2019

54. In a cyclotron, magnetic field of 1.4 Wb/m^2 is used. To accelerate protons. how rapidly should the electric field between the Dees be reversed?
($\pi = 3.142$, $M_p = 1.67 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19}$C)

Maharashtra Board-2018

55. Is the steady electric current the only source of magnetic field? Justify your answer.

CBSE Delhi-2013C

56. Use the expression F = q (v × B) to define the SI unit of magnetic field.

CBSE All India-2010C

57. Draw the magnetic field lines due to a current carrying loop.

CBSE Delhi-2013C

58. Show that the radius of a charged particle entering perpendicularly in a magnetic field is directly proportional to its momentum.

ISC-2004

59. A beam of α-particles projected along +X-axis, experiences a force due to a magnetic field along the +Y-axis. What is the direction of the magnetic field?

CBSE All India-2010

60. When a charge q is moving in the presence of electric (E) and magnetic (B) fields which are perpendicular to each other and also perpendicular to the velocity v of the particle, write the relation expressing v in terms of E and B.

CBSE All India-2019

61. The dimensional formula for magnetic field strength is…..

J&K Board-2018

62. A wire of length *l* is bent in the form of a square and carries a current I. What is the value of its magnetic moment?

Nagaland Board-2017

63. A straight wire of 1.4 m long carries a current of 7 A at right angles to a uniform magnetic field of 0.01 T. Calculate the mechanical force acting on the wire due to the magnetic field.

Nagaland Board-2017

64. The magnetic field in a plane electromagnetic wave is:

$$B_y = 2\times10^{-7}\sin\left(0.5\times10^3 x + 1.5\times10^{11} t\right) \text{ Tesla.}$$

What is the wavelength and frequency of the wave?

Haryana Board-2018

65. If the magnetic field is parallel to the +ve x-axis and the charged particle is moving along +ve y - axis. Which direction would the Lorentz force act

(a) for an electron (b) for a proton?

Gujarat Board-2023

66. A force acts on a charged particle moving in a magnetic field but this force does not change the speed of the particle. Explain.

NIOS-2018

67. An electron of energy 45 eV is revolving in circular path in magnetic field of intensity 9 × 10^{-5} weber/m^2. Find the radius of circular path.

UP Board-2023

68. (b) Two protons P and Q moving with the same speed pass through the magnetic fields $\vec{B_1}$ and $\vec{B_2}$ respectively, at right angles to the field directions. If $|\vec{B_2}| > |\vec{B_1}|$, which of the two protons will describe the circular path of smaller radius? Explain.

CBSE-2019

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69. A small flat search coil of area 5 cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0.09 T and then quickly removed out of the field region. Calculate
(a) change of magnetic flux through the coil, and
(b) emf induced in the coil.

CBSE-2019
CBSE All India-2019

70. Write the relation for the force acting on a charged particle q moving with velocity $\vec{v}$ in the presence of a magnetic field $\vec{B}$.

CBSE-2019

71. A particle of charge q and mass m starts moving with uniform velocity $v_0\hat{i}$. Specify the direction of magnetic field which should be set be set up in the region so that the particle moves (a) straight undeviated, and (b) in a circle. justify your answers.

CBSE-2023

72. A charged particle enters a magnetic field with velocity v in a direction perpendicular to the field. Find an expression for the radius of the circular path of the particle 2

Assam Board-2013

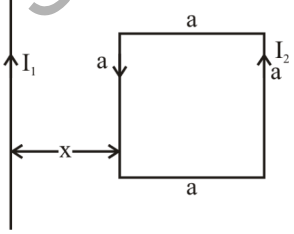
73. There exists a non uniform magnetic field in free space. A charged particle of mass m and velocity v enters the field and comes out after a certain time. Comment with reason about the Kinetic energy of the particle after coming out of the field.

Assam Board-2017

74. Why is the Cyclotron not used to accelerate electrons?

Assam Board-2015

75. A square loop of side a carrying a current I_2 is kept at distance x from an infinitely long straight wire carrying a current I_1 as shown in the figure. Obtain the expression for the resultant force acting on the loop.



CBSE Delhi-2019

76. Define one tesla using the expression for the magnetic force acting on a particle of charge q moving with velocity v in a magnetic field B.

CBSE Foreign-2014

77. A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30° with the direction of the motion of the particle. Draw the trajectory followed by the particle in the presence of the field and explain how the particle describes this path.

CBSE Delhi-2019

78. When does the force on a charged particle moving in a magnetic field is maximum?

Karnataka Board-July, 2016, 2019

79. A charged particle enters an magnetic field in the direction of magnetic field. What is the nurture of the path traced by it?

Karnataka Board-July, 2015

80. When does force experienced by a straight current carrying conductor placed in a uniform magnetic field become (a) maximum and (b) minimum?

Karnataka Board-July, 2020

81. Find the formula of radius obtained by a charged particle entering perpendicularly in a uniform magnetic field.

Uttarakhand Board-2020

82. What will be the path followed by charged particle moving along magnetic field.

Bihar Board-2023

83. In a vertically upwards magnetic field $\vec{B}$, positively charged particle is projected horizontally eastwards. What will be the direction of force on the particle ?

Bihar Board-2023

84. Derive an expression for magnitude of magnetic dipole moment of a revolving electron.
A circular coil of 300 turns and diameter 14 cm carries a current of 15A. Calculate the magnitude of the magnetic dipole moment associated with the coil.

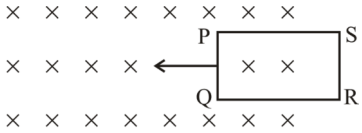
Maharashtra Board-2020

Section-C (Short Answer)

85. Explain in detail the principle, construction and working of a cyclotron.

Jharkhand Board-2020
CBSE-2019
Haryana Board-2018
NIOS-2017
Nagaland Board-2017
Tamil Nadu Board-2015
CBSE Delhi-2011C, 2014, 2019

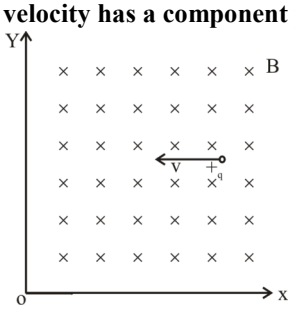
86. The closed loop PQRS of wire is moved into a uniform magnetic field at right angles to the plane of the paper as shown in the figure. Predict the direction of the induced current in the loop.



CBSE Foreign-2012

Search On TG: @apna_pdf

87. A point charge +q moving with speed $\vec{V}$ enters a uniform magnetic field $\vec{B}$ that is acting into the plane of paper as shown.
i) What is the path followed by the charge +q ?
ii) What would be the change in the path if its velocity has a component parallel to $\vec{B}$?



Goa Board-2019

88. Draw a labelled diagram of cyclotron. Explain its working principle. Show that cyclotron frequency is independent of the speed and radius of the orbit.

CBSE-2019

89. Explain the limitations of cyclotron.

J&K Board-2020

90. A cyclotron is used to accelerate protons to a kinetic energy of 5 MeV. If the strength of magnetic field in the cyclotron is 2T, find the radius and the frequency needed for the applied alternating voltage of the cyclotron.
(Given: Velocity of proton = 3×10^7 m/s)

Maharashtra Board-2019

91. A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30° with the direction of the motion of the particle. Draw the trajectory followed by the particle in the presence of the field and explain how the particle describes this path.

CBSE-2019

92. A stream of deutrons is projected with a velocity of 10^4 ms^{-1} in XY-plane. A uniform magnetic field of induction 10^{-3} T acts along the Z-axis. Find the radius of the circular path of the particle. (Mass of deutron is 3.32×10^{-27} kg and charge of deutron is 1.6×10^{-19}C).

Tamil Nadu Board-2017

93. A particle moves in a circle of diameter 2 cm under the action of a magnetic field 0.80 tesla. An electric field 100 V/m makes the path straight. Find the specific charge $\left(\frac{q}{m}\right)$ of the particle.

UP Board-2018

94. With the help of a suitable diagram, explain the principle of working of a cyclotron. Derive the expression for
(a) the cyclotron frequency, and
(b) the kinetic energy acquired by the ion accelerated in the cyclotron.

CBSE-2020

95. Show that the angular frequency of a charged particle moving in a circular path in magnetic field is independent of its velocity

Assam Board-2013

96. A conductor of mass m and length *l* is placed on a table along east-west direction. Suddenly a certain amount of charge is passed through it and it is found to jump to a height h. What was the amount of charge passed? The horizontal magnetic induction of earth is B. Acceleration due to gravity is g.

Assam Board-2017

97. (i) Obtain the expression for the cyclotorn frequency.
(ii) A deuteron and a proton are accelerated by the cyclotorn. Can both an accelerated with the same oscillator frequency? Give reason to justify your answer.

CBSE Delhi-2017

98. Give an expression for force acting on a charge moving in magnetic field and explain the symbols, when does the force become maximum.

Karnataka Board-July, 2014

Section-D (Long Answer)

99. With the help of a schematic diagram, explain the principle of a cyclotron. Hence, deduce the expression of cyclotron frequency.

Chhattisgarh Board-2023
Nagaland Board-2021
J&K Board-2018

100. (i) State the basic principle of a cyclotron. Explain how it works to accelerate the charged particles. Write its one important use.
(ii) A cyclotron oscillator frequency is 10 MHz. What should be the applied magnetic field for accelerating protons? ($e = 1.6 \times 10^{-19}$ C, $m_p = 1.67 \times 10^{-27}$ kg)

Chhattisgarh Board-2019

101. Explain the working of a cyclotron with the help of diagram. Why electron cannot be accelerated using it?

Haryana Board-2016, 2017

102. Draw the schematic sketch of a cyclotron. Explain the shape of the path on which charged particle moves when the particle is accelerated by it.

CBSE-2020

103. Particles of mass 1.6×10^{-27} kg and charge 1.6×10^{-19} C are accelerated in a cyclotron of dee radius 40 cm. It employs a magnetic field 0.4 T. Find the kinetic energy (in MeV) of the particle beam imparted by the accelerator.

CBSE-2020

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104. An α-particle and a proton are released from the centre of the cyclotron and made to accelerate.

(a) Can both be accelerated at the same cyclotron frequency? Give reason to justify your answer.

(b) When they are accelerated in turn, which of the two will have higher velocity at the exit slit of the dees?

CBSE Delhi-2012

105. Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity or energy of the particle.

CBSE Delhi-2014

106. A uniform magnetic field B is set up along the positive X-axis. A particle of charge q and mass m moving with a velocity v enters the field at the origin in XY-plane such that it has velocity components both along and perpendicular to the magnetic field B.

Trace, giving reason, the trajectory followed by the particle. Find out the expression for the distance moved by the particle along the magnetic field in one rotation.

CBSE All India-2011

107. (i) An electron accelerated by a potential difference of 10^4V enters into a uniform magnetic field of 0.04 Tesla acting perpendicular to its velocity. Find the radius of curvature of the projectile path.

(ii) How much current should flow in a long straight wire so that at a distance of 10 cm from the wire, a magnetic field of 1×10^4 weber/m^2 generated.

Uttarakhand Board-2023]

III. Magnetic Field Due to Current Dlement, Biot-Savart

Section-A (Multiple Choice Questions)

108. Magnetic field at any point at a distance R due to a long straight conductor carrying current varies as:

(a) R^2 (b) R

(c) $\frac{1}{R^2}$ (d) $\frac{1}{R}$

Tamil Nadu Board-2023

Ans. (d) : j

109. Two parallel wires carrying current in same direction will :

(a) Repel each other (b) Attract each other

(c) Both (d) None

Haryana Board-2016

Ans. (b) : j

110. A circular coil of radius 10 cm having 100 turns carries a current of 3.2 A. The magnetic field at the centre of the coil is

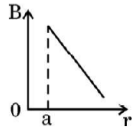
(a) 2.01×10^{-3} T (b) 5.64×10^{-3} T

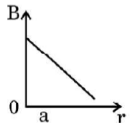
(c) 2.64×10^{-4} T (d) 5.64×10^{-4} T

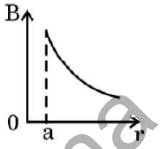
Jharkhand Board-2023

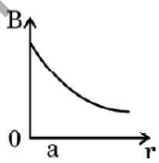
Ans. (a) : j

111. Which of the following graphs correctly represents the variation of the magnitude of the magnetic field outside a straight infinite current carrying wire of radius 'a', as a function of distance 'r' from the centre of the wire ?

(a)


(b)


(c)


(d)


CBSE-2023

Ans. (c) : j

112. A long straight wire of radius 'a' carries a steady current 'I'. The current is uniformly distributed across its area of cross-section. The ratio of magnitude of magnetic field $\vec{B}_1$ at $\frac{a}{2}$ and $\vec{B}_2$ at distance 2a is

(a) $\frac{1}{2}$ (b) 1 (c) 2 (d) 4

CBSE-2023

Ans. (b) : j

113. A current of 10A is flowing from east to west in a long straight wire kept on a horizontal table. The magnetic field developed at a distance of 10 cm due north on the table is:

(a) 2×10^{-5} T, acting downwards

(b) 2×10^{-5} T, acting upwards

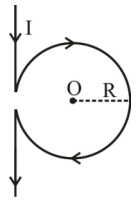
(c) 4×10^{-5} T, acting downwards

(d) 4×10^{-5} T, acting upwards

CBSE-2020

Ans. (a) : j

114. A current I flows through a long straight conductor which is bent into a circular loop of radius R in the middle as shown in the figure.



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The magnitude of the net magnetic field at point O will be

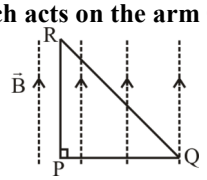
(a) Zero (b) $\frac{\mu_0 I}{2R}(I+\pi)$

(c) $\frac{\mu_0 I}{4\pi R}$ (d) $\frac{\mu_0 I}{2R}\left(1-\frac{1}{\pi}\right)$

CBSE-2020

Ans. (d) : j

115. An isosceles right angled current carrying loop PQR is placed in a uniform magnetic field $\vec{B}$ pointing along PR. If the magnetic force acting on the arm PQ is F, then the magnetic force which acts on the arm QR will be



(a) F (b) $\frac{F}{\sqrt{2}}$

(c) $\sqrt{2}F$ (d) –F

CBSE-2020

Ans. (d) : j

116. The expression $\sum \vec{B}.\Delta\vec{S} = 0$ is

(a) Gauss Law in Electrostatics
(b) Gauss Law in Magnetism
(c) Ampere's circuital law
(d) Lenz's law

Kerala Board-2021

Ans. (b) : j

117. If a coil of metal wire is kept stationary in a uniform magnetic field, then .....

(a) an e.m.f. is induced in the coil
(b) a current is induced in the coil
(c) neither e.m.f. nor current is induced
(d) both current and e.m.f. are induced

Maharashtra Board-2020

Ans. (c) : j

118. The shape of magnetic lines of force due to an infinitely long straight current-carrying wire is

(i) straight line (ii) circular
(iii) elliptic (iv) hyperbolic

Odisha Board-2022

Ans. (b) : j

119. Which of the following relations is correct for magnetic field due to a straight current carrying conductor of infinite length ?

(a) $B = \frac{\mu_0 I}{2\pi R}$ (b) $B = \frac{\mu_0 R}{2\pi I}$

(c) $B = \frac{I}{\mu_0 R}$ (d) $B = \frac{2I}{\mu_0 R}$

Bihar Board-2021

Ans. (a) : j

120. The mathematical formula of Biot-Savart law is

(a) $\vec{dB} = \frac{\mu_0}{4\pi} I \frac{\vec{dl}\times\vec{r}}{r^3}$ (b) $\vec{dB} = \frac{\mu_0}{4\pi} \frac{i\vec{dl}\times\vec{r}}{r^2}$

(c) $\vec{dB} = \frac{\mu_0}{4\pi} I \frac{\vec{dl}\times\vec{r}}{r^4}$ (d) $\vec{dB} = \mu_0 \frac{\vec{dl}\times\vec{r}}{r}$

MP Board-2015, 2023
Bihar Board-2022
ISC-2013
Tamil Nadu Board-2015, 2016
Gujarat Board-2022
MP Board-2023

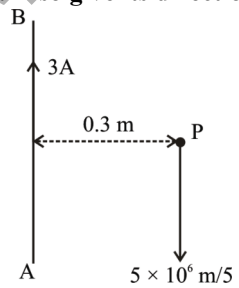
Ans. (b) : j

Section-B (Very Short Answer)

121. Derive formula for the force acting between two parallel current carrying conductors.

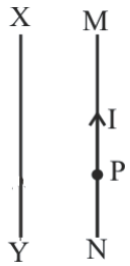
MP Board-2020

122. A long straight wire AB carries a current of 3A. A proton P travels at 5×10^6 m/s parallel to the wire 0.3 m from it and in a direction opposite to the current as shown in the figure. Calculate the force which the magnetic field due to the current carrying wire exerts on the proton. Also give its direction.



CBSE-2019

123. Figure alongside shows a point P near a long conductor XY carrying a current I. MN is a short current conductor, kept at the point P, parallel to the conductor XY. What is the direction of magnetic flux density 'B' at the point P due to the current flowing through XY ?



ISC-2012

124. Calculate the magnetic field (in SI unit) at the centre of a tangent galvanometer coil of 50 turns and radius 10 cm when a current of 1.0 A passes through it.

ISC-2007

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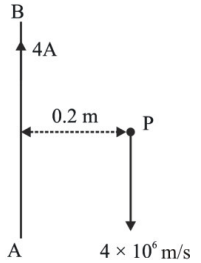
125. State Biot-Savart's law.

Odisha Board-2020, 2023
Kerala Board-2021
MP Board-2014
ISC-2001, 2005, 2014

126. Two coils P and Q of radius R and 2R are lying in the same plane with their centres coinciding. Find the magnitude and direction of the resultant magnetic field at the common centre if they respectively carry currents 3I and 2I in opposite directions.

CBSE-2019

127. A long straight wire AB carries a current of 4A. A proton P travels at 4×10^6 ms^{-1} parallel to the wire 0.2 m from it and in a direction opposite to the current as shown in the figure. Calculate the force which the magnetic field due to the current carrying wire exerts on the proton. Also specify its direction.



CBSE-2019

128. A long straight conductor kept along X' X axis, carries a steady current I along + x direction. At an instant t, a particle of mass m and charge q at point (x, y) moves with a velocity $\vec{v}$ along + y direction. Find the magnitude and direction of the force on the particle due to the conductor.

CBSE-2023

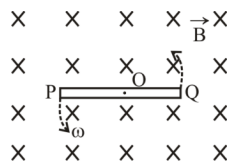
129. A wire of length L is bent round in the form of (i) a square, and then (ii) an equilateral triangle. If current I is passed through each of them, find the ratio of magnetic moment of the square loop to that of the triangle.

CBSE-2023

130. A circular loop carrying a current 5 A, produces a magnetic field of π mT, at its centre. Find the value of the magnetic moment of the loop.

CBSE-2020

131. A metallic rod PQ of length *l* is rotated with an angular velocity ω in a magnetic field $\vec{B}$ about an axis passing through the mid-point O of the rod and perpendicular to the plane of paper as shown in the figure. What is the potential difference developed between the points O and Q of the rod?



CBSE-2020

132. Show that Weber = Volt × Second.

Assam Board-2014

133. A straight wire of length L is bent into a semi-circular loop. Use Biot-Savart's law to deduce an expression for the magnetic field at its centre duet to the current I passing through it.

CBSE Delhi-2011C

134. Given an application of cyclotron.

Karnataka Board-July, 2018

135. Write the expression for cyclotron frequency and explain the terms.

Karnataka Board-July, 2018

Section-C (Short Answer)

136. A long straight wire of circular cross - section (radius a) carrying steady current I. The current I is uniformly distributed across the cross-section. Calculate the magnetic field in the region r < a and r > a .

Gujarat Board-2023

137. With the help of Biot-Severt's law, obtain an expression for intensity of magnetic field near s straight, long current carrying conductor.

MP Board-2017

138. Explain Biot-Savart law for magnetic field produced due to an element of a current carrying conductor and use it to define the SI unit of current ampere.

MP Board-2019

139. State Biot-Savert law and using it deduce the expression for magnetic field due to a current carrying conductor of length L and current I at perpendicular distance x from it.

UP Board-2018

140. Use Biot-Savart's law to derive the expression for the magnetic field on the axis of a current carrying circular loop of radius R.
Draw the magnetic field lines due to a circular wire carrying current (I).

CBSE Delhi-2016

141. Find magnetic flux density at a point on the axis of a long solenoid having 5000 turns/m when it is carrying a current of 2A.

ISC-2014

142. Using Ampere's circuital law or Biot-Savart's law, show that magnetic flux density B at a point P at a perpendicular distance 'a' from a long current carrying conductor is given by

$$B = \left(\frac{\mu_0}{4\pi}\right)\frac{2I}{a}$$ **[Statement of the laws not required]**

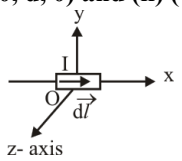
ISC-2011, 2005

Search On TG: @apna_pdf

143. (a) Depict the magnetic field lines due to a circular current carrying lop showing the direction of field lines.

(b) A current I is flowing in a conductor placed along the x-axis as shown in the figure. Find the magnitude and direction of the magnetic field due to a small current element $\vec{dl}$ laying at the origin at points

(i) (0, d, 0) and (ii) (0, 0,d)



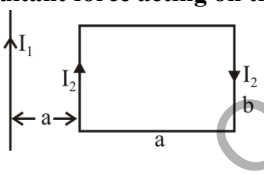
CBSE-2019

144. Two infinitely long straight wires A_1 and A_2 carrying currents I and 2I flowing in the same directions are kept 'd' distance apart. Where should a third straight wire A_3 carrying current 1.5 I be placed between A_1 and A_2 so that it experiences no net force due to A_1 and A_2 ? Does the net force acting on A_3 depend on the current flowing through it?

CBSE-2019

145. (a) Define the term 'self inductance' of a coil. Write its S.I. unit

(b) A rectangular loop of sides a and b carrying current I_2 is kept at a distance 'a' from an infinitely long straight wire carrying current I_1 as shown in the figure. Obtain an expression for the resultant force acting on the loop.

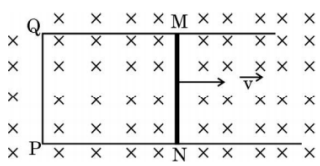


CBSE-2019

146. A rectangular conductor MNPQ with a movable arm MN (resistance r) is kept in a uniform magnetic field as shown in the figure. Resistance of arms MQ, QP and PN are negligible. Obtain the expression for the:

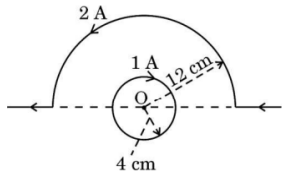
(a) current induced in the loop specifying its direction, and

(b) power required to move the arm.



CBSE-2023

147. A current carrying circular loop and a straight wire bent partly in the form of a semicircle are placed as shown in the figure. Find the magnitude and direction of net magnetic field at point O.



CBSE-2023

148. Two parallel Co-axial Coils of equal radius R and numbers of turn N carrying equal currents I in same direction are separated by a distance R. Show that the magnetic field intensity B on the axis around the mid point between the coils is uniform over a very small distance as compared to R and is given by –

$$B = \left(\frac{4}{5}\right)^{3/2} \cdot \frac{\mu_o IN}{R}$$

Assam Board-2017

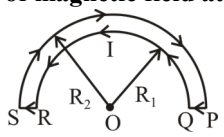
149. A current carrying conductor produces a magnetic field in the surrounding space.

(a) Name the law which gives the relation between current and the magnitude of the field it produces.

(b) Using this law obtain the equation for the magnetic field on the axis of a circular current loop.

Kerala Board-2016

150. The wire loop PQRSP formed by joining two semi-circular wires of radii R_1 and R_2 carries a current I as shown in the figure below. Find the magnitude of magnetic field at O.



Meghalaya Board-2019

151. State Biot-Savart law and express the law in vector form.

CBSE-2018C
CBSE All India-2017
Meghalaya Board-2014

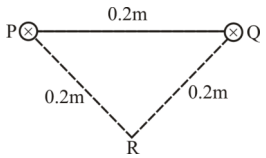
152. Calculate the value of magnetic field at a distance of 3 cm from a very long, straight wire carrying a current of 6Å.

Maharashtra Board-2022

153. Use Biot-Savart law to derive the expression for the magnetic field due to a circular coil carrying current at a point P along its axis. Draw necessary diagram. What is the direction of magnetic field at P it the current is in anticlockwise direction ? equilibrium?

Goa Board-2019
CBSE-2018C

154.



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The figure shows two infinitely long and this parallel wires P and Q placed 0.2 m apart perpendicular to the plane of the paper , carrying equal current of 20 A each. Find the magnetic field at a point R at a distance of 0.2 m from both the wires. The symbol ⊕ indicates the current is directed inward.

Goa Board-2018

155. (i) State Biot- Savart's law and express this law in the vector form.

(ii) Two identical circular coils, P and Q each of radius R, carrying currents 1A and $\sqrt{3}$ a respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.

CBSE All India-2017

156. Write three uses of cyclotron.

Karnataka Board-March, 2014
Karnataka Board-July, 2014

Section-D (Long Answer)

157. Using Biot-Savart Law deduce the relation for the magnetic field at a point due to an infinitely long straight conductor carrying current.

Tamil Nadu Board-2022

158. Using Biot-Savart law, find an expression for the magnetic field at a point on the axis of a circular current-carrying loop. Hence find the expression for the magnetic field at its centre.

Meghalaya Board-2018

159. Using the Biot-Savart law, find an expression for the magnetic field at the centre of a circular coil of radius r and carrying a current I.

Meghalaya Board-2015

160. Using Biot-Savart law, obtain an expression for the magnetic field at a point on the axis of circular current loop.

J&K Board-2014

161. (ii)Two long and parallel straight wires carrying currents of 2A and 5A in the opposite directions are separated by a distance of 1cm. Find the nature and magnitude of the magnetic force between them.

CBSE Delhi-2012
CBSE Foreign-2011

162. Using Biot Savart's law derive an expression for magnetic field intensity produced at a point due to current flowing through an infinite long straight conductor.

Chhattisgarh Board-2018
J&K Board-2012

163. State Biot Savart's law. Derive an expression for the magnetic field at the centre of circular coil carrying current.

Tamil Nadu Board-2016, 2023
Chhattisgarh Board-2023
CBSE-2023
J&K Board-2019, 2022, 2023
Gujarat Board- March, 2022
MP Board-2018
Haryana Board-2016
ISC-2015

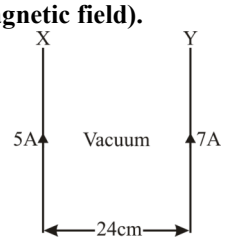
164. State Biot-Savart's law and write its mathematical formula. Deduce an expression for magnetic field produced by a current carrying straight conductor of finite length. Hence show that magnetic field produced at a point by current carrying straight conductor of infinite length at a perpendicular distance d from it is $B = \frac{\mu_o I}{2\pi d}$. Draw necessary diagram.

Meghalaya Board-2013
Rajasthan Board-2011

165. Two electrons are moving in concentric circular orbits of the same radius, 8.5×10^{-4} m with the same speed, 3×10^{7} ms^{-1} in mutually perpendicular planes. Calculate the magnitude and direction of the resultant magnetic field at the centre of the orbit. (Given : Mass of electron = 9×10^{-31} kg, charge of electron = 1.6×10^{-19} C)

NIOS-2012

166. (i) Two infinitely long current carrying conductors X and Y are kept parallel to each other, 24 cm apart in vacuum. They carry currents of 5A and 7A respectively, in the same direction, as shown in figure below. Find the position of a neutral point, i.e. a point where resultant magnetic flux density is zero. (Ignore earth's magnetic field).



(ii) If current through the conductor Y is reversed in direction, will neutral point lie between X and Y, to the left of X or to the right of Y ?

ISC-2016

167. (i) Write an expression for Biot-Savart's law in the vector form. Write an expression for the magnetic field at the centre of a circular coil of radius R, with N turns and carrying a current I.

(ii) A helium nucleus completes one round of a circle of radius 0.8m is 2s. Find the magnetic field at the centre of the circle.

ISC-2001, 2006, 2009

168. A circular coil N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius R/2, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

ISC-2003

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169. Deduce the expression for the magnetic dipole moment of an electron orbiting around the central nucleus.

ISC-2001

170. Derive an expression for the force acting on a current carrying straight conductor kept in a magnetic field. State the rule which is used to find the direction of this force. Give the condition under which this force is (1) maximum, and (2) minimum.

CBSE-2023

171. Two long parallel straight wires A and B are 2.5 cm apart in air. They carry 5.0 A and 2.5 A currents respectively in opposite directions. Calculate the magnitude of the force exerted by wire A on a 10 cm length of wire B.

CBSE-2023

172. An electron is revolving around the nucleus in a circular orbit with a speed of 10^7 m s^{-1}. If the radius of the orbit is 10^{-10} m, find the current constituted by the revolving electron in the orbit.

CBSE-2023

173. A charged particle of mass m and charge q is projected with a velocity v making an angle θ with the direction of a uniform magnetic field of induction B. Find the expressions for –

(i) Time period of revolution

(ii) Pitch of the helical path followed by the particle

Assam Board-2015

174. The relation between magnetic field and current is given by Biot-Savart law.

(a) Illustrate Biot-Savart law with necessary figure.

(b) Compare Biot-Savart law with Coloumb's law for electrostatic field.

(c) Give an expression for magnetic field on the axis of a circular current loop. (Expression only).

(d) What is the value of B at the centre of the loop?

Kerala Board-2014

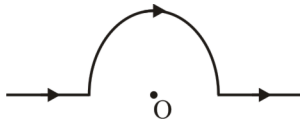
175. (i) Using Biot-Savart's law, deduce an expression for the magnetic field on the axis of a circular current carrying loop.

(ii) Draw the magnetic field lines due to a current carrying loop.

(iii) A straight wire carrying a current of 12A is bent into a semi-circular are of radius 2.0 cm as shown in the figure. What is the magnetic field B at O due to

(a) straight segments and

(b) the semi-circular arc?



CBSE Foreign-2010

176. State Biot-Savart's law and give the mathematical expression for it.

Use this law to derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis.

How does a circular loop carrying current behave as a magnet?

CBSE-2023

Uttarakhand Board-2020

Karnataka Board- July, 2018

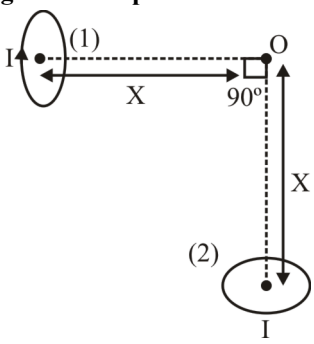
Karnataka Board- March, 2015

CBSE Delhi-2011

177. State Biot-Savart's law expressing it in the vector form. Use it to obtain the expression for the magnetic field at an axial point distance d from the centre of a circular coil of radius a carrying current I. Also, find the ratio of the magnitudes of the magnetic field of this coil a the centre and at an axial point for which d = $a\sqrt{3}$.

CBSE Delhi-2013C

178. Two very small identical circular loop (1) and (2) carrying equal current I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point O.



CBSE Delhi-2014

179. (i) Write using Biot-Savart law, the expression for the magnetic field B due to an element dI carrying current I at a distance r from it in a vector form.

Hence, derive the expression for the magnetic field due to a current carrying loop of radius R at a point P and distance x from its centre along the axis of the loop.

(ii) Explain how Biot-Savart law enables one to express the Ampere's circuital law in the integral form, viz.

$$\oint B.dl = \mu_0 I$$

Where, I is the total current passing through the surface.

CBSE Delhi-2015

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IV. Magnetic Field on the Axis of a Circular Current Loop

Section-A (Multiple Choice Questions)

180. If the number of turns, area and current through a coil are n, A and I respectively, then its magnetic moment is

(a) n^2IA (b) nIA^2
(c) nIA (d) nI^2A

Meghalaya Board-2018

Ans. (c) : j

181. The magnetic field at the centre of a circular coil of radius r and carrying current I is given by:

(a) $\mu_0 nI$ (b) $\frac{\mu_0 I}{2\pi r}$
(c) $\frac{\mu_0 I}{2r}$ (d) Zero

Haryana Board-2017

Ans. (c) :

182. A straight wire of mass 200g and length 1.5m carries a current of 2A. To suspend it in a air by a uniform horizontal magnetic field, value of required magnetic field is ——T.

(a) 0.45 (b) 6.5
(c) 0.65 (d) 4.5

Gujarat Board- March, 2020

Ans. (c) : j

183. Assertion (A) : A current carrying square loop made of a wire of length L is placed in a magnetic field. It experiences a torque which is greater than the torque on a circular loop made of the same wire carrying the same current in the same magnetic field.

Reason (R) : A square loop occupies more area than a circular loop, both made of wire of the same length.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.

CBSE-2023

Ans. (c) : j

184. Assertion (A) : When radius of a circular loop carrying a steady current is doubled, its magnetic moment becomes four times.

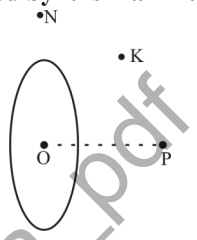
Reason (R): The magnetic moment of a circular loop carrying a steady current is proportional to the area of the loop.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.

CBSE-2023

Ans. (a) : j

185. Figure shows a circular coil with centre 'O' . if current flows through the coil, the magnetic field produced by it is maximum at



(a) Point O (b) Point P
(c) Point K (d) Point N

Goa Board-2023

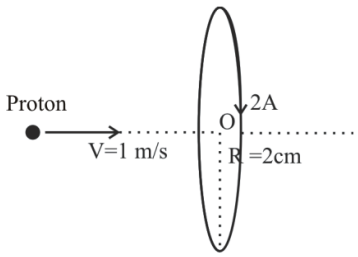
Ans. (a) : j

Section-B (Very Short Answer)

186. Mention an expression for the magnetic field produced at the centre of the axis of a current carrying solenoid and explain the terms.

Karnataka Board-July, 2019

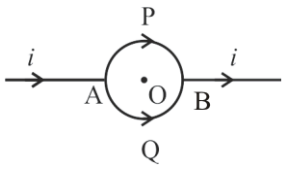
187.



The velocity vector of a proton is directed perpendicular to the plane of a current loop at its center O as shown in the figure. What will be the force acting on the proton at the centre of the loop ?

Goa Board-2018

188. Consider the circuit shown where APB and AQB are semicircles, What will be the magnetic field at the centre O of the circle?



Haryana Board-2022

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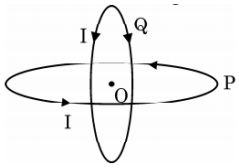
189. Draw a diagram of the magnetic field lines due to a current carrying circular loop.

Rajasthan Board-2022

190. Establish the formula for intensity of magnetic field at the centre of a current carrying circular coil.

MP Board-2015

191. Two identical circular loops P and q, each of radius R carrying current I are kept in perpendicular planes such that they have a common centre O as shown in the figure.



Find the magnitude and direction of the net magnetic field at point O.

CBSE-2019, 2023

192. Two wires of equal lengths are shaped in the form of a square loop and a circular loop. Both loops are suspended in a uniform magnetic field. Prove that for the same current, the circular loop will experience larger torque.

CBSE-2023

193. A current of 0.40 A is flowing through a coil of radius 8.0 cm and having 100 turns. Find the magnetic field at its centre.

(f) (i) Derive the expression for motional emf as $\varepsilon = Blv$. Where the symbols have their usual meaning.

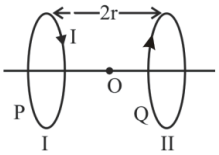
(ii) A current of 4.0 A is flowing in a coil. If the current suddenly falls to 0.0A in 0.1 s an average emf of 200V is induced. Calculate the coefficient of self induction of the coil.

(g) The household line voltage of 220V is an_____value with a peak voltage of 311 V (Fill in the blank). Establish an expression relating the terms P, V, and R.

(h) (i) A tank is filled with water to a height of 12.5 cm. The apparent depth of needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water ?

Assam Board-2023

194. Two identical circular loops P and Q, each of radius r and carrying equal currents are kept in the parallel planes having a common axis passing through O. The direction of current in P is clockwise and in Q is anti-clockwise as seen from O which is equidistant from the loops P and Q. find the magnitude of the net magnetic field at O.



CBSE Delhi-2012

195. A wire of length 10cm, carrying 10A of current is placed at an angle of 53° with respect to a magnetic field B of strength 0.1 T. Find the force experienced by the wire. $\left[\text{Use}, \sin 53° = \frac{4}{5}\right]$

ISC-2004

195. A 100 turn closely wound circular coil of radius 10 cm carries a current of 3.2 A. What is the magnetic field at the centre of the coil.

Uttarakhand Board-2022

Section-C (Short Answer)

196. A circular coil of radius 20cm has 100 turns wire and it carriers a current of 5 A. find the magnetic induction at a point along its axis at a distance of 20 cm from the centre of the coil

Tamil Nadu Board-2017

197. A square coil of side 10 cm consists of 20 turns and carries a current of 12A. the coil is suspended vertically and the normal to the plane of the coil makes an angle of 30º with the direction of a uniform horizontal magnetic field of magnitude 0.80 T. What is the magnitude of torque experienced by the coil?

Gujarat Board- July, 2022

198. Two circular loops A and B, each of radius 3 m, are placed coaxially at a distance of 4 m. They carry currents of 3 A and 2 A in opposite directions respectively. Find the net magnetic field at the centre of loop A.

CBSE-2023

199. (a) Write an expression of magnetic moment associated with a current (I) carrying circular coil of radius r having N turns.

(b) Consider the above mentioned coil placed in YZ plane with its center at the origin. Derive expression for the value of magnetic field. Due to it at point (x, 0, 0).

CBSE-2020

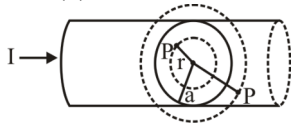
200. A rectangular coil of turns n and area A is rotating with angular velocity ω in a uniform magnetic field B. Find an expression for the e.m.f. generated in the coil.

Assam Board-2013

201. A circular coil of radius R and N turns carries a current I. Show that the intensity of magnetic field at an axial point distant x from the centre is $B = \frac{\mu_0 NIR^2}{2\left(R^2 + X^2\right)^{3/2}}$

Kerala Board-2021

202. Figure shows a long straight wire of a circular cross-section of radius a carrying steady current I. The current I is uniformly distributed across this cross-section Derive the expressions for the magnetic field in the region (i) r < a and (ii) r > a.



CBSE All India-2011C

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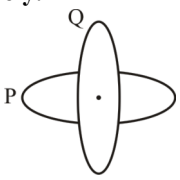
203. Two identical loops P and Q each of radius 5 cm are lying in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common center of the two coils, if they carry currents equal to 3A and 4A, respectively.



CBSE Delhi-2017

204. A circular coil of N turns and radius R carries a current I. It is unwound and rewound to make another square coil of side 'a' keeping number of turns and current same. Calculate the ratio of magnetic moment of the square coil to the circular coil.

Manipur Board-2022

205. What is a cyclotron ? Draw its neat diagram labeled the parts.

Karnataka Board-July, 2020

Section-D (Long Answer)

206. Derive an expression for the magnetic field at a point on the axis of a current carrying circular coil. Also find the magnetic field at the centre of the coil.

Jharkhand Board-2019

207. Deduce an expression for magnetic field at a point on the axis of a current carrying circular coil.

Chhattisgarh Board-2020

208. A circular loop of radius R carries a current I. Obtain an expression for the magnetic field at a point on its axis at a distance x from its centre.

CBSE-2020

209. Derive the expression for magnetic field at a point on the axis of a circular current loop. Also find the magnetic field at the centre of the loop.

Assam Board-2023

210. Derive and expression for the magnetic field intensity produced at a point lying along the axis of a circular coil carrying current.

Kerala Board-2017

211. With the help of a diagram, briefly describe the construction and working of a cyclotron. Also find (a) the radius of the circular path and (b) the time period of revolution of an ion in a cyclotron.

Meghalaya Board-2015

212. Derive the expression for magnetic field at a point on the axis of a circular current loop.

Karnataka Board-March, 2014, 2015, 2017

V. Ampere's Circuit Law and Solenoid

Section-A (Multiple Choice Questions)

213. The magnitude of magnetic field inside a long solenoid having n number of turns per unit length and carrying current I is :

(a) $\mu_o nI$ (b) $\frac{\mu_o nI}{\pi}$

(c) $\mu_o I$ (d) Zero

Haryana Board-2016

Ans. (a) : j

214. There are 100 turns per cm length in a very long solenoid. It carries a current of 5A. The magnetic field at its center on the axis is ——T.

(a) 9.42×10^{-2} (b) 6.28×10^{-2}

(c) 3.14×10^{-2} (d) 12.56×10^{-2}

Gujarat Board- May, 2021

Ans. (b) : j

215. A very long solenoid of length L has n layers. There are N turns in each layer. Diameter of the solenoid is D and it carries current I .The magnetic field at the centre of the solenoid is——.

(a) Independent of D

(b) Inversely proportional to D

(c) Directly proportional to D

(d) Directly proportional to L

Gujarat Board- May, 2021

Ans. (a) : j

216. The formula for magnetic energy density for a solenoid is

(a) $\frac{B^2}{2\mu_0}$ (b) $\frac{B}{2\mu_0}$

(c) $\frac{2\mu_0}{B^2}$ (d) $\frac{B}{4\pi\mu_0}$

Bihar Board-2023

Ans. (a) : j

Section-B (Very Short Answer)

217. State and explain Ampere's law.

AP Board-2023, 2020

Bihar Board- 2021

218. Derive $B = \mu_0 nI$ for the toroid.

Gujarat Board- July, 2022

219. State Ampere's circuital law.

Karnataka Board-2014, 2015, 2019

Telangana Board-2018

Maharashtra Board-2018

Tamil Nadu Board-2018

Assam Board-2014, 2016

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220. **In a current carrying solenoid the current is flowing clockwise from left end. Draw the magnetic field produced in it.**

Rajasthan Board-2011

221. **A long straight wire of a circular cross-section of radius a carries a steady current I. The current is uniformly distributed across the cross-section. Apply Ampere's circuital law to calculate the magnetic field at a point in the region for (i) r < a and (ii) r > a.**

CBSE Delhi-2010

222. **Derive the equation $B = \frac{\mu_0}{4\pi}\frac{2m}{r^3}$ for the axial magnetic field for finite Solenoid. m is the magnetic moment of Solenoid & r is the distance of the point from the centre of Solenoid.**

Gujarat Board-2023

223. **Mention two ways by which the strength of a given electromagnet can be increased.**

NIOS-2017

224. **A 0.5 m long solenoid of 10 turns/cm has area of cross-section 1 cm^2. Calculate the voltage induced across its ends if the current in the solenoid is changed from 1 A to 2 A in 0.1 s.**

CBSE-2019

225. **Write the mathematical form of Ampere-Maxwell circuital law .**

CBSE-2020

226. **Ampere's theorem helps to find the magnetic field in a region around a current carrying conductor.**

(a) Write the expression of Ampere's theorem.

(b) Draw a graph showing the variation of intensity of magnetic field with the distance from the axis of a current carrying conductor.

Kerala Board-2020

227. **An air cored solenoid has 1000 turns per metre and carries a current of 2A. Calculate the magnetic intensity (H).**

Kerala Board-2021

228. **Using Ampere's circuital theorem, calculate the magnetic field due to an infinitely long wire carrying a current *I*.**

Meghalaya Board-2021

229. **Obtain an expression for magnetic induction of a toroid of 'N' turns about an axis passing through its centre and perpendicular to its plane.**

Maharashtra Board-2023

230. **Obtain with the help of a necessary diagram, the expression for the magnetic field in the interior of a toroid carrying current.**

CBSE All India-2011C

231. **A long solenoid of length L having N turns carries a current I. Deduce the expression for the magnetic field in the interior of the solenoid.**

CBSE All India-2011C

232. **What is the magnetic moment associated with a solenoid?**

Telangana Board-2018

Section-C (Short Answer)

233. **A solenoid of length 50cm, having 100 turns carries a current of 2.5A. Find the magnetic field (B), (a) in the interior of the solenoid, (b) at one end of the solenoid. Given $\mu_o = 4\pi\times10^{-7}$ Wb $A^{-1}m^{-1}$.**

Punjab Board-2018

234. **Obtain an expression for magnetic field on the axis of current carrying vey long solenoid by Ampere's circuital law. Draw necessary diagram.**

Rajasthan Board-2023

235. **(a) Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length *l* of the solenoid.**

(b) Derive the equation for magnetic energy density.

Gujarat Board-August, 2020

236. **State Ampere's circuital law. Using this law find the magnetic field at a point inside a current carrying toroid. Hence find magnetic field at a point inside a long solenoid carrying current.**

Nagaland Board-2020
Jharkhand Board-2018
Kerala Board-2017
Meghalaya Board-2017
Assam Board-2014

237. **State Ampere's circuital law. Express it in mathematical form. Use this law to find a relation for the magnetic field due to an infinitely long-current carrying conductor.**

NIOS-2016

238. **What is Ampere's circuital law? Explain Ampere-maxwell modified law and explain displacement current with its help.**

UP Board-2020

239. **Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why ?**

CBSE-2019

240. **(a) Derive, with the help of a diagram, the expression for the magnetic field inside a very long solenoid having n turns per unit length carrying a current I.**

(b) How is a toroid different from a solenoid?

CBSE-2019

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241. **A long solenoid having 15 turns per cm has a small loop of area 2sq. cm placed inside the solenoid normal to its axis. If the change of current in the solenoid is 2.0A in 0.1s, find the induced emf in the loop.**

Assam Board-2023

242. **Using Ampere's circuital law show that the intensity of magnetic field at an axial point near the centre of a current carrying solenoid is $B = \mu_0 n I$.**

Kerala Board-2021

243. **What is a solenoid? considering an air -cored solenoid of length *l*, area of cross-section A and having total number of turns N, show that the coefficient of self - inductance L is given by**

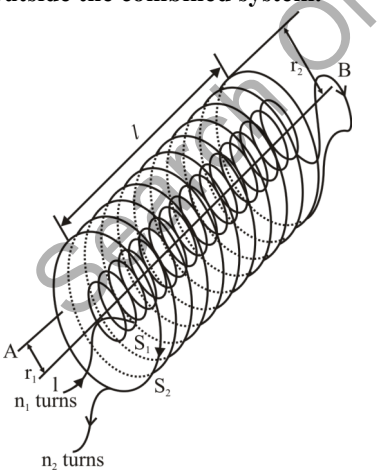
$$L = \frac{\mu_0 N^2 A}{l}$$

Meghalaya Board-2023

244. **(i) How is a toroid different from a solenoid?**
(ii) Use Ampere's circuital law to obtain the magnetic field inside a toroid.

CBSE All India-2014C

245. **Two long co-axial insulated solenoids S_1 and S_2 of equal length are wound one over the other as shown in the figure. A steady current I flows through the inner solenoid S_1 to the other end B which is connected to the outer solenoid S_2 through which the some current I flows in the opposite direction so, as to come out at end A. If n_1 and n_2 are the number of turns per unit length, find the magnitude and direction of the net magnetic field at a point.**
(a) inside on the axis and
(b) outside the combined system.



CBSE Delhi-2014

246. **(i) Derive with the help of diagram, the expression for the magnetic field inside a very long solenoid having n turns per unit length carrying a current I.**
(ii) How is a toroid different from a solenoid?

CBSE All India-2019

247. **State Ampere's circuital law. Show through an example, how this law enables an easy evaluation of the magnetic field when there is a symmetry in the system?**

CBSE All India-2010

Section-D (Long Answer)

248. **Write Ampere's circuital law and by using this law derive the expression for intensity of magnetic field inside a current-carrying solenoid.**

Chhattisgarh Board-2022
J&K Board-2011, 2018, 2021

249. **An air cored solenoid has a length 25 cm and diameter of 2.0 cm. It contains 1000 very closely wound turns. When a ac source with emf 200 V and frequency 100 Hz is connected across it an effective current of 2A flows through it. Calculate the**
(i) inductance
(ii) impedance and
(iii) resistance of the solenoid

NIOS-2022

250. **Briefly explain various ways to increase the strength of magnetic field produced by a given solenoid**

CBSE-2023

251. **Show that a current carrying solenoid behaves like a small bar magnet. Obtain the expression for the magnetic field at an external point lying on its axis.**

CBSE-2020

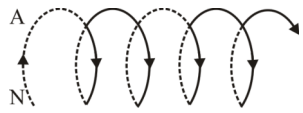
252. **A steady current of 2A flows through a circular coil having 5 turns of radius 7 cm. The coil lies X-Y plane with its centre at the origin.**
Find the magnitude and directions of the magnetic dipole moment of the coil.

CBSE-2020

253. **State Ampere's circuital law and arrive at the expression for the magnetic field near a straight infinite current carrying wire.**

Karnataka Board-July, 2015, 2018
ISC-2005

254. **(i) State Ampere's circuital law. Use this law to obtain the expression for the magnetic field inside an air cored toroid of average radius r, having n turns per unit length and carrying a steady current I.**
(ii) An observer to the left of a solenoid of N turns each of cross-section areas A observers that a steady current I flows in the clockwise direction.
Depict the magnetic field lines due to the solenoid specifying its polarity and slow that it acts as a bar magnet of magnetic moment m = NIA



CBSE All India-2015

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255. State Ampere's circuital law expressing it in the integral form.

CBSE Delhi-2014

256. State the Ampere's circuital law. Use the law to find the magnitude of the magnetic field inside a long, straight, air-cored solenoid. Also write the expressions for the magnitude of magnetic field (i) at points near the ends of the solenoid and (ii) inside the solenoid when it is iron-cored.

Meghalaya Board-2014

257. (i) State Ampere's circuital law. Show through an example, how this law enables an easy evaluation of this magnetic field when there is a symmetry in the system.

(ii) What does a toroid consist of? Show that for an ideal toroid of closely would turns, the magnetic field

(a) inside the toroid is constant.

(b) in the open space inside and exterior to the toroid is zero.

CBSE All India-2010C

258. (i) State Ampere's circuital law.

(ii) Use it to derive an expression for magnetic field inside along the axis of an air cored solenoid.

(iii) Sketch the magnetic field lines for a finite solenoid. How are these field lines different from the electric field lines from an electric dipole?

CBSE Foreign-2010

259. (i) Using Ampere's circuital law, obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis.

(ii) In what respect, is a toroid different from a solenoid? Draw and compare the pattern of the magnetic field lines in the tow cases.

(iii) How is the magnetic field inside a given solenoid made strong?

CBSE All India-2011

260. State and explain Biot-Savart law and Ampere's circuital law. Apply Ampere's law to find an expression for the magnetic field at a distance d from an infinitely long straight current-carrying conductor.

Odisha Board-2022

261. Derive an expression for the intensity of magnetic field at any point on the axis of a circular current loop.

Karnataka Board-March, 2019

262. Derive the expression for magnetic field at a point on the axis of a circular current loop.

Karnataka Board-March, 2014, 2015, 2017

263. (a) State and prove Ampere's circuital law. 3

(b) Two long and parallel straight wires A and B, carrying currents of 8.0 A and 5.0 A in the same direction, are separated by a distance of 4.0 cm. Estimate the force on 10 cm section of wire A.

Uttarakhand Board-2019

VI. Force between Two Parallel Currents

Section-A (Multiple Choice Questions)

264. Two long parallel wires kept 2 m apart carry 3A current each, in the same direction. The force per unit length on one wire due to the other is

(a) 4.5×10^{-5} Nm^{-1}, attractive

(b) 4.5×10^{-7} N/m, repulsive

(c) 9×10^{-7} N/m, repulsive

(d) 9×10^{-5} N/m, attractive

CBSE-2023

Ans. (c) : j

265. Beams of electrons and protons move parallel to each other in the same direction. They

(a) attract each other

(b) repel each other

(c) neither attract nor repel

(d) force of attraction or repulsion depends upon speed of beams

CBSE-2023

Ans. (b) : j

266. A moving electron centres a uniform and perpendicular magnetic field. Inside the magnetic field, the electron travels along

(a) a straight line (b) a parabola

(c) a circle (d) a hyperbola

ISC-2015

Ans. (c) : j

267. Two parallel long thin wires, each carrying current I are kept at a separation r from each other. Hence the magnitude of force per unit length of one wire due to the other wire is_____.

(a) $\frac{\mu_0 I^2}{2\pi r}$ (b) $\frac{\mu_0 I^2}{r^2}$

(c) $\frac{\mu_0 I}{2\pi r}$ (d) $\frac{\mu_0 I}{2\pi r^2}$

Gujarat Board- March, 2019

Ans. (a) : j

268. The force per unit length between two long straight parallel current-carrying wires is directly proportional to

(a) r (b) r^{-1}

(c) r^{-2} (d) r^2

(here r is the distance of separation between the two wires)

Meghalaya Board-2013

Ans. (b) : j

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Section-B (Very Short Answer)

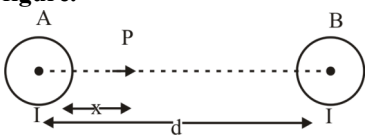
269. Two parallel wires each of length 5 m are placed at a distance of 10 cm apart in air. They carry equal currents along the same direction and experience a mutually attractive force of 3.6×10^{-4} N. Find the current through the conductors.

Tamil Nadu Board-September, 2016

270. When the nature of force between two parallel current carrying conductor becomes attractive and repulsive ?

UP Board-2018

271. Two long straight parallel wires A and B separated by a distance, d carry equal current I flowing in same direction as shown in the figure.



(a) Find the magnetic field at a point P situated between them at a distance x form one wire.

(b) Show graphically the variation of the magnetic field with distance x for $0 < x < d$.

CBSE-2020

272. The force acting in between two parallel wires of length 10m carrying current of 1A through each of them and placed 1m apart in vacuum will be_____.

Assam Board-2023

271. Write an expression for the force per unit length between two infinitely long straight parallel current carrying wires. Hence define 1 ampere.

Meghalaya Board-2021

273. Calculate the force per unit length between two parallel long straight wires 2 cm apart in air, each carrying a current of 4A.

Meghalaya Board-2018

274. What is the nature of force between two parallel conductors carrying current in same direction?

Karnataka Board-July, 2014

Section-C (Short Answer)

275. A solenoid is 2m long and 3cm in diameter. has 5 layers of winding of 1000 turns. each carries a current of 5A. Find magnetic induction at its centre along its axis and also at the ends.

J&K Board-2022

276. Two long and parallel straight wires A and B carrying currents of 8 A and 5 A in the same direction are separated by a distance of 4 cm. Estimate the force on a 10cm section of wire A.

Gujarat Board-March, 2022

277. Find the forece acting on a current carrying conductor in uniform magnetic field. Using it find the force between two parallel current carrying conductors.

Jharkhand Board-2023

278. Deduce an expression for the force acting between two current carrying parallel straight conductors and hence define 1 ampere of current with its help

UP Board-2020

279. Two infinitely long parallel conductors A and B, separated by 2 cm, carry 6 A and 2 A currents in opposite directions respectively. Find: (a) the net magnetic field at a point midway between A and B. (b) the force acting per unit length on B.

CBSE-2023

280. Two long and parallel straight conductors A and B are carrying currents of 8.0 A and 5.0 A in the same direction. A and B are separated by a distance of 4.0 cm. Calculate the force on a 10 cm portion of wire A.

Assam Board-2023

281. Two parallel wires carrying current in the same direction attract each other while two beams of electrons travelling in the same direction repel each other. Explain why.

Meghalaya Board-2015, 2019

Karnataka Board-2015, 2016

182. Calculate the current flowing through two long parallel wires carrying equal currents and separated by a distance of 1.35 cm experiencing a force per unit length of 4.75×10^{-2} N/m.

Maharashtra Board- 2023

Section-D (Long Answer)

283. Derive an expression for the force between two parallel straight conductors carrying currents in the same direction. Hence define one ampere.

Haryana Board-2018

284. Find the force acting on a current carrying conductor in uniform magnetic field. Using it find the force between two parallel current carrying conductors.

Jharkhand Board -2019

Karnataka Board - 2015

285. (i) Derive expression of force acting per unit length of two long straight parallel current carrying conductors.

(ii) Use above expression to define one ampere current.

Chhattisgarh Board-2019

286. Two long straight thin conductors carrying currents I_1 and I_2 respectively along the same direction are placed parallel to each other in air. Derive an expression for the force per unit length acting on any one of the conductors and hence define one ampere current.

Assam Board-2015

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287. **(i) Establish the formula for the force acting between two parallel current carrying conductors.**

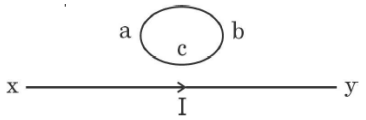
(ii) Find the distance between two parallel wires, while the electric currents of 100 ampere and 20 ampere flow in them respectively and they repel each other with a force of 0.08 Newton/ meter and what will be the direction of the currents?

Uttarakhand Board-2023

VII. Torque on Current Loop Magnetic Dipole

Section-A (Multiple Choice Questions)

288. **The direction of induced current in the loop abc is :**



(a) along abc if I decreases
(b) along acb if I increases
(c) along abc if I is constant
(d) along abc if I increases

CBSE-2023

Ans. (d) :

289. **A wire of length 1 m is made into a circular loop and it carries a current of 3.14A. The magnetic dipole moment of the current loop (in Am^2) is:**

(a) 1 (b) 0.5
(c) 0.25 (d) 0.314

Tamil Nadu Board-March, 2016

Ans. (c) :

290. **The torque acting on an electric dipole of dipole moment P placed at an angle 90° to the electric field E will be.**

(a) PE (b) PE cosθ
(c) PE/sinθ (d) Zero

Haryana Board-2017

Ans. (a) :

291. **A straight steel wire of length *l* has magnetic moment m. If the wire is bent in the form of a semicircle, what is the new value of the magnetic dipole moment?**

(a) $\frac{2m}{\pi}$ (b) m
(c) $\frac{m}{2}$ (d) $\frac{m}{\pi}$

Gujarat Board- March, 2019

Ans. (a) : j

292. **The torque $(\vec{\tau})$ experienced by a current loop of magnetic moment $(\vec{m})$ placed in magnetic field $\vec{B}$ is**

(a) $\vec{\tau} = \vec{m} \times \vec{B}$ (b) $\vec{\tau} = \vec{B} \times \vec{m}$
(c) $\vec{\tau} = \frac{\vec{m}}{\vec{B}}$ (d) $\vec{\tau} = \vec{m} \cdot \vec{B}$

Bihar Board-2019, 2022

Ans. (a) : j

293. **The radius of a circular current loop is made double and the current is made half. The magnetic moment of the loop will become**

(a) Halved (b) Doubled
(c) Four times large (d) None of these

Bihar Board-2023

Ans. (b) : j

Section-B (Very Short Answer)

294. **Write the equation for magnetic dipole kept at angle "θ"in an uniform magnetic field and derive the equation of periodic time for its motion.**

Gujarat Board- August, 2020

295. **An electric dipole with dipole moment 4×10^{-9} C-m. is inclined at 30° with the direction of a uniform electric field of magnitude $5 \times 10^4 NC^{-1}$. Calculate the magnitude of torque acting on the dipole.**

Jharkhand Board-2019

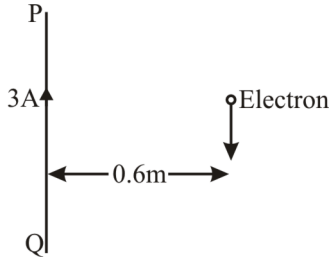
296. **Establish the expression for torque acting on a magnetic dipole placed in a uniform magnetic field.**

Chhattisgarh Board-2019

297. **Define ampere in terms of force between two current carrying conductors.**

ISC-2016

298. **An electron is moving vertically upwards in the uniform magnetic field of the Earth. The velocity of the electron is 2.0×10^6 m/s and the horizontal component of the Earth's magnetic field is 0.32×10^{-4} T. Obtain the magnitude and direction of the force on the electron.**



ISC-2000

299. **Figure below shows two infinitely long and thin current carrying conductors X and Y kept in vacuum, parallel to each other at a distance a.**

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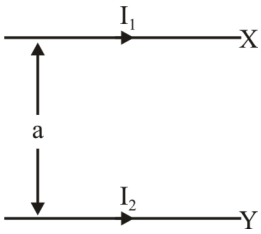


(i) How much force per unit length act on the conductor Y due to the current flowing through X ? Write your answer in terms of $\left(\frac{\mu_0}{4\pi}\right)$, I_1 I_2 and a.

[Derivation of formula is not required]

(ii) Define ampere in terms of force between two current carrying conductors.

ISC-2016, 2013, 2011, 2008

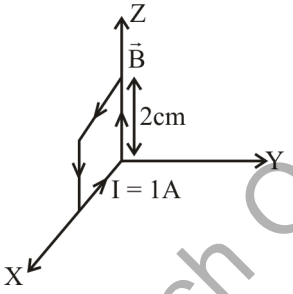
300. An electron , moving with a velocity of 5×10^7 ms^{-1} , enters in a magnetic field of 1 Wb m^{-2} at an angle of 30°. Calculate the force on the electron.

ISC-2006, 2001

301. When does a moving charged particle not experience any force while moving through a uniform magnetic field ?

ISC-2014

302. Find the magnitude and direction of the torque acting on the square loop as shown in the diagram where B = 1.5T along positive Z-axis.



Assam Board-2017

306. A 100 turn closely wound circular coil of radius 10 cm carries a current of 3.2 A. What is the field at the centre of the coil?

AP Board-2022

307. Define magnetic moment. Write its S.I. unit and dimension.

Bihar Board-2023

365. Write an expression for magnetic field due to straight conductor carrying current.

Haryana Board-2016

Section-C (Short Answer)

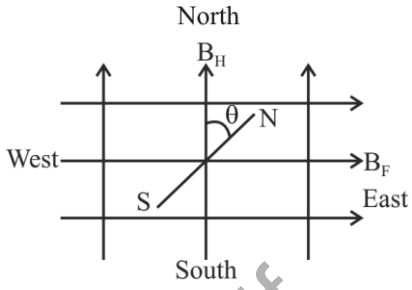
308. Write the expression in a vector form for the Lorentz magnetic force F due to a charge moving with velocity v in a magnetic field B. What is the direction of the magnetic force?

CBSE Delhi-2014

309. Derive an expression for the torque acting on a current carrying rectangular coil placed in a uniform magnetic field.

Jharkhand Board-2020

310. A small magnetic needle NS having magnetic dipole moment P_m is kept in two uniform and perpendicular magnetic fields B_F and B_H as shown below.



(i) What is the effect of each of the magnetic fields B_F and B_H on the needle ?

(ii) When the needle is in equilibrium, obtain an expression for angle θ made by the needle with B_H in terms of B_F and B_H only.

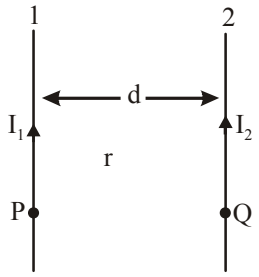
ISC-2010

311. Obtain the formula, I = kθ for a moving coil galvanometer given the deflecting torque τ = M × B, where M is the magnetic dipole moment of the coil placed in the magnetic field B, I is the current in the galvanometer and θ is the deflection.

ISC-2008

312. Two very long conductors carrying currents I_1 and I_2 are separated by a distance d as shown in the figure. Give the expressions (do not derive) for the magnetic fields B_{12} and B_{21} at P and Q respectively produced by the electric currents I_2 and I_1. What are the directions of these fields ?

Define the SI unit of currents using the below set up.



ISC-2007

313.(a) Show that the time period (T) of oscillations of a freely suspended magnetic dipole of magnetic moment (m) in a uniform magnetic field (B) is given by $T = 2\pi\sqrt{\frac{I}{mB}}$, where I is moment of inertia of the magnetic dipole.

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(b) Identify the following magnetic materials :
(a) A material having susceptibility (x_m) = – 0.00015.
(b) A material having susceptibility(Xm) = 10^{-5}.

CBSE-2019

314. Find the following expression for the magnetic moment of an electron moving in a circular path

$$\mu_e = \frac{e}{2m_e} l$$

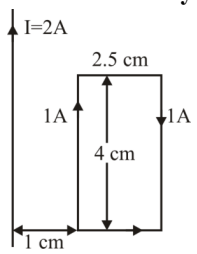
Where l is the angular momentum of the electron about the nucleus, e and m_e are its charge and mass.

Assam Board-2013

315. Obtain an expression for the torque on a rectangular current carrying loops suspended in a uniform magnetic field. Angle between the magnetic field and the normal to the coil is θ. draw necessary diagram in which orientation will the loop be in stable equilibrium?

Goa Board-2019

316. A rectangular loop of wire of size 2.5 cm × 4 cm carries steady current of 1A. A straight wire carrying 2A current is kept near the loop as shown. If the loop and the wire are coplanar, find the (i) torque acting on the loop and (ii) the magnitude and direction of the force on the loop due to the current carrying wire.

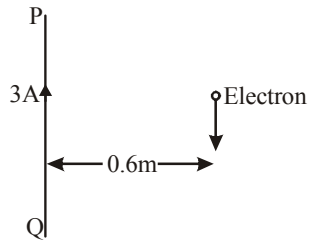


CBSE Delhi-2012

Section-D (Case-Based Questions)

217. (i) Using ampere's circuital law, obtain an expression for the magnetic flux density B at a point X at a perpendicular distance r from a long current carrying conductor. (Statement of the law is not required).

(ii) PQ is a long straight conductor carrying a current of 3A as shown in figure iv below. An electron moves with a velocity of 2×10^7 ms^{-1} parallel to it. Find the force acting on the electron.



ISC-2017

103. Force acting on a charged particle when it moves in a combined electric and magnetic field is known as Lorentz force.
(a) A charged particle is released from rest in a region of steady and uniform electric and magnetic fields; which are parallel to each other. What will be the nature of the path followed by the charged particle? Explain your answer.
(b) A rectangular loop carrying a steady current is placed in a uniform magnetic field. Obtain the expression for the torque acting on the loop.

Kerala Board-2013

318. An electron beam passes through a region in which a magnetic field of 2×10^{-3} T and an electric field 3.4×10^4 V/m both acting simultaneously at right angles to each other. If the path of the electron remains undeflected, calculate the speed of the electrons. If the electric field is removed, what will be the radius of the circular path of electrons ?

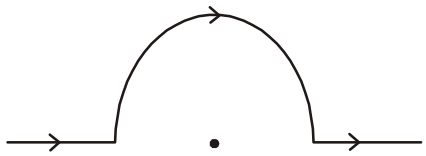
ISC-2002

Section-E (Long Answer)

319. (a) State and explain the law used to determine magnetic field at a point due to a current element. Derive the expression for the magnetic field due to a circular current carrying loop of radius r at its centre.
(b) A long wire with a small current element of length 1 cm is placed at the origin and carries a current of 10 A along the X-axis. Find out the magnitude and direction of the magnetic field due to the element on the Y-axis at a distance 0.5 m from it.

CBSE-2019

320. (a) Derive the expression for the magnetic field due to a current carrying coil of radius r at a distance x from the centre along the x-axis.
(b) A straight wire carrying a current of 5 A is bent into a semicircular arc of radius 2 cm as shown in the figure. Find the magnitude and direction of the magnetic field at the centre of the arc.



CBSE-2019

321. A square loop of sides 5 cm carrying a current of 0.2 A in the clockwise direction is placed at a distance of 10 cm from an infinitely long wire carrying a current of 1 A as shown. Calculate (i) the resultant magnetic force, and (ii) the torque, if any, acting on the loop.

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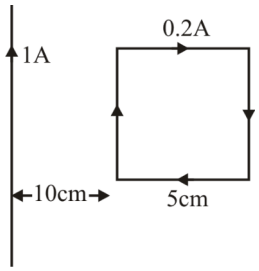

CBSE-2019

322. A rectangular loop of area A and carrying a steady current I is placed in a uniform magnetic field.

(a) Derive the expression of torque, $\tau = \vec{m} \times \vec{B}$, acting on the loop.

(b) Increasing the current sensitivity may not necessarily increase the voltage sensitivity of a galvanometer. Justify.

Kerala Board-2020

323. Obtain an expression for period of magnetic dipole kept in a uniform magnetic field and hence obtain an expression for magnetic field.

Karnataka Board-July, 2020

VIII. The Moving Coil Galvanometer

Section-A (Multiple Choice Questions)

324. Phosphor-bronze wire is used for suspension in a moving coil galvanometer, because it has:

(a) high conductivity
(b) high resistivity
(c) large couple per unit twist
(d) small couple per unit twist

Tamil Nadu Board-2017

Ans. (d) : j

325. An ideal voltmeter has

(a) zero resistance
(b) finite resistance less than G but greater than zero
(c) resistance greater than G but less than infinity
(d) infinite resistance.

Tamil Nadu Board-2011

Ans. (d) : j

326. To convert a galvanometer into a voltmeter, we must connect a

(a) high resistance in parallel with the galvanometer
(b) high resistance in series with the galvanometer
(c) low resistance in parallel with the galvanometer
(d) low resistance in series with the galvanometer

Goa Board-2023
Meghalaya Board-2019

Ans. (b) : j

327. The resistance of an ideal ammeter is

(a) high resistance (b) low resistance
(c) zero resistance (d) infinite resistance

Bihar Board-2022

Ans. (c) : j

328. If any ammeter is shunted, then the total resistance of the circuit

(a) increases (b) decreases
(c) remains same (d) none of these

Bihar Board-2023

Ans. (a) : j

Section-B (Very Short Answer)

329. Which alloys are used for making standard resistance coils?

J&K Board-2021

223. What is a Shunt?

MP Board-2021

330. Write the underlying principle of a moving coil galvanometer.

CBSE Delhi-2015

331. A galvanometer has a resistance of 40Ω. It shows full scale deflection for a current of 2 mA. How will you convert the galvanometer into a voltmeter of range 0 to 20 V?

Rajasthan Board-2022
Tamil Nadu Board-2016

332. How will you increase the current sensitivity of a galvanometer ?

Tamil Nadu Board-2022

333. A galvanometer of resistance 100 Ω which can measure a maximum current of 1 mA is converted into an ohmmeter by connecting a battery of emf 1 V and fixed resistance of 900 Ω in series. When an external resistance is measured the current reading is 0.1 mA. Calculate the value of the resistance.

Tamil Nadu Board-2017

334. Explain how you will convert a galvanometer into a voltmeter.

Tamil Nadu Board-2011

335. Why ammeters are connected in series in electric circuits.

J&K Board-2018

336. What are magnetic lines of force? Why two such lines do not cross each other?

Or

Why should an ammeter have as low a resistance as possible? Explain.

J&K Board-2023

338. If full scale of deflection is obtained in galvanometer, of resistance 99 ohms by passing a current 10^{-1} A in it, what arrangement is required to measure a current of 1 A from it?

MP Board-2013

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339. How is a moving coil galvanometer converted into an ammeter?
MP Board-2021

340. In a moving coil galvanometer the magnetic field is made radial. Why and how?
MP Board-2021

342. Define current sensitivity of a moving coil galvanometer.
UP Board-2020

343. State two factor on which the sensitivity of a moving coil galvanometer depends.
ISC-2006

344. In a moving coil galvanometer, what is meant by a radial magnetic field ?
ISC-2012

345. define the term 'current sensitivity' of a moving coil galvanometer.
MP Board-2021
Karnataka Board-2019, 2020
CBSE-2020
UP Board-2020
Nagaland Board-2017
ISC - 2001

346. A galvanometer of resistance 16 Ω shows full scale deflection for a current of 4 mA. How will you convert it into a voltmeter to measure a voltage up to 3 V?
CBSE-2020

347. An ammeter of resistance 0.8 Ω can measure a current up to 1.0A. Find the value of shunt resistance required to convert this ammeter to measure a current up to 5.0 A.
CBSE-2020

348. A galvanometer of resistance 30 ohm shows a full scale deflection for a current of 2 mA. Calculate the value of resistance required to convert it into a voltmeter of range 0–5 volt.
J&K Board-2019

349. How is a moving coil galvanometer converted into a voltmeter ? Explain giving the necessary circuit diagram and the required mathematical relation used.
CBSE All India-2011C

350. Why does a moving coil galvanometer use concave magnetic poles?
Manipur Board-2022

351. A galvanometer having a coil of resistance 12Ω gives full scale deflection for a current of 4mA. How can it be converted into a voltmeter of range 0 to 24 V?
Karnataka Board-July, 2016

352. A galvanometer coil has a resistance of 15□. The meter shows full scale deflection for a current of 4 mA. How will you convert the galvanometer into ammeter of range 0 to 6A? 2
Uttarakhand Board-2019

353. What is the principle of a moving coil galvanometer?
AP Board-2023

Section-C (Short Answer)

354. Explain the conversion of galvanometer into voltmeter.
Tamil Nadu Board-2023

355. How can a galvanometer be converted into ammeter? Find its resistance.
Maharashtra Board-2023
CBSE-2023
Kerala Board-2021
MP Board-2021
Punjab Board-2019
ISC-2016
J&K Board-2012, 2016

337. When a galvanometer with a shunt is joined in an electrical circuit, 2% of the total current passes through the galvanometer, Resistance of galvanometer is G. find the value of shunt. 1
Gujarat Board- May, 2021

92. State the principle of a moving coil galvanometer. Explain its working and obtain the expression for the deflection produced due to the current passed through the coil. Define current sensitivity.
CBSE-2019

93. Explain how a galvanometer can be converted into an ammeter of a given range. Derive an expression for shunt resistance and current for full scale deflection. Find the effective resistance of the ammeter.
CBSE-2019

356. With the help of a diagram, explain the principle and working of a moving coil galvanometer.
Nagaland Board-2018

357. Explain how a moving coil galvanometer can be converted into
(i) an ammeter and
(ii) a voltmeter of a given range.
Uttarakhand Board-2022
Nagaland Board-2020

98. Explain with circuit diagram how to convert galvanometer into a voltmeter.
Karnataka Board-March, 2017

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358. Describe with principle, the construction and working of a moving coil galvanometer.

Jharkhand Board-2018

359. Explain the principle construction and working of a moving coil galvanometer with the help of a labelled diagram.

NIOS-2017

360. (a) Explain the current sensitivity of moving coil galvanometer. Mention the factors affecting it. How a galvanometer can be used as of voltmeter?

UP Board-2021

361. (a) Briefly explain how a galvanometer is converted into an ammeter.

(b) A galvanometer coil has a resistance of 15 Ω and it shows full scale deflection for a current of 4 mA. Convert it into an ammeter of range of 0 to 6 A.

CBSE-2019

362. (a) Briefly explain how a galvanometer is converted into a voltmeter.

(b) A voltmeter of a certain range is constructed by connecting a resistance of 980 Ωin series with a galvanometer. When the resistance of 470 Ω is connected in series, the range gets halved. Find the resistance of the galvanometer.

CBSE-2019

363. (a) State the underlying principle of a moving coil galvanometer.

(b) Give two reason to explain why a galvanometer cannot as such be used to measure the value of the current in a given circuit.

(c) Define the terms;

(i) voltage sensitivity and (ii) current sensitivity of a galvanometer

CBSE-2019

364. (a) Briefly describe how the current sensitivity of a moving coil galvanometer can be increased.

(b) A galvanometer shows full scale deflection for current I_g. A resistance R_1 is required to convert it into a voltmeter of range (0 – V) and a resistance R_2 to convert it into a voltmeter of range (0 – 2V). Find the resistance of the galvanometer.

CBSE-2023

365. (a) Define current sensitivity of a galvanometer. Write its expression.

(b) A galvanometer has resistance G and shows full scale deflection for current Ig.

(i) How can it be converted into an ammeter to measure current up to I_0 ($I_0 > I_g$) ?

(ii) What is the effective resistance of this ammeter?

CBSE-2020

366. (a) With the help of a diagram, explain the working of a moving coil galvanometer. Justify the necessity of using radial magnetic field in it.

CBSE-2020

367. (b) A galvanometer can be converted into a voltmeter to measure up to

(i) V volt by connecting a resistance 2 kΩ in series with the galvanometer.

(ii) 2V volt by connecting a resistance 5 kΩ in series with the galvanometer.

Calculate the resistance that should be connected in series with the galvanometer to convert it into a voltmeter to measure up to $\frac{V}{2}$ volt.

CBSE-2020

368. Describe the working of a moving coil galvanometer.

Assam Board-2014

369. Depending on the requirement, a moving coil galvanometer can be used as a current detector, an ammeter or a voltmeter.

(a) Write the principle of a moving coil galvanometer.

(b) Using a suitable diagram arrive at an expression for the current sensitivity of a moving coil galvanometer.

Kerala Board-2016

370. (a) Why are pole pieces of a magnet within a galvanometer made concave ?

(b) Name the elements of earth's magnetic field.

(c) Write the expression for Lorentz force.

Meghalaya Board-2021

371. State the advantages and disadvantages of a moving coil galvanometer.

A moving coil galvanometer(M.C.G.) has 10 turns each of length 12 cm and breadth 8 cm. The coil of M.C.G. carries a current of 125 μA and is kept perpendicular to the uniform magnetic field of induction 10^{-2}T. The twist constant of phosphor bronze fibre is 12×10^{-9} Nm/degree. Calculate the deflection produced.

Maharashtra Board-2020

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372. (i) When this loop is placed in a magnetic field B, find out the expression for the torque acting on it.

(ii) A galvanometer coil of 50 Ω resistance shows full scale deflection for a current of 5mA. How will you convert this galvanometer into a voltmeter of range 0 to 15V?

CBSE Foreign-2011

373. A moving coil galvanometer of resistance G gives its full scale deflection when a current I_g flows through its coil. It can be converted into a ammeter of range (0 to I) ($I > I_g$) when a shunt of resistance S is connected, find the expression for the shunt required in terms of I_g and G.

CBSE Delhi-2010C

374. Draw a labelled diagram of a moving coil galvanometer and explain its working. What is the function of radial magnetic field inside the coil?

CBSE Foreign-2012

375. State the principle of working of a galvanometer. A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R_1 in series with the coil. If a resistance R_2 is connected in series with it, then it can measure upto V/2 volts. Find the resistance, in terms of R_1 and R_2, required to be connected to convert it into a voltmeter that can read upto 2V. Also, find the resistance G of the galvanometer in terms of R_1 and R_2.

CBSE All India-2015

376. (i) State the underlying principle of a moving coil galvanometer.

(ii) Give two reasons to explain why a galvanometer cannot as such be used to measure the value of the current in a given circuit.

(iii) Define the terms (i) voltage sensitivity and (ii) current sensitivity of a galvanometer.

CBSE Delhi-2019

377. Derive the expression for energy stored in a current carrying coil.

Karnataka Board-July, 2015

378. Show with the help of a circuit diagram how a moving coil galvanometer can be converted into an ammeter of the given range.

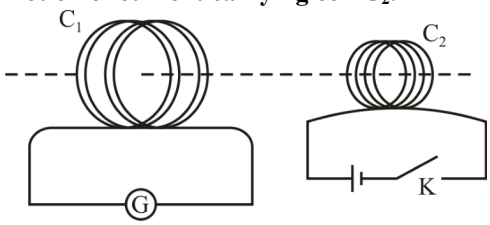
Uttarakhand Board-2023

Section-D (Case-Based Questions)

107. Give the principle construction and working of moving coil galvanometer.

J&K Board-2017

292. A current is induced in coil C_1 due to the motion of current carrying coil C_2.



(i) Write any two ways by which a large deflection can be obtained in the galvanometer G.

(ii) Suggest an alternative device to demonstrate the induced current in place of a galvanometer.

CBSE Delhi-2011

379. Describe the working of a moving-coil galvanometer and hence show that the deflection of the coil is directly proportional to the current flowing through it.

Meghalaya Board-2013

Section-E (Long Answer)

380. Describe the principle and construction of a moving coil galvanometer. Prove that current flowing in the coil is directly proportional to its deflection.

Kerala Board-2017
J&K Board-2014, 2015

381. Explain the principle and working of a moving coil galvanometer with the help of a labelled diagram.

Haryana Board-2018

382. Explain the principle of a moving coil galvanometer. How can it be converted into an ammeter?

Haryana Board-2018

383. Explain moving coil galvanometer on the following point.

(i) Labelled diagram

(ii) Principle

Chhattisgarh Board-2022

384. What is moving coil galvanometer? Draw labelled diagram of suspended coil galvanometer and prove that the deflection of a coil is directly proportional to the current flowing through it.

Chhattisgarh Board-2020

385. To convert a given galvanometer into a voltmeter of ranges 2V, V and $\frac{V}{2}$ volt, resistances R_1, R_2 and R_3 ohm respectively, are required to be connected in series with the galvanometer. Obtain the relationship between R_1, R_2 and R_3.

CBSE-2020

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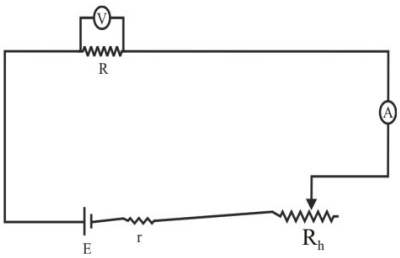
386. Obtain the expression for the deflecting torque acting on the current carrying rectangular coil of a galvanometer in a uniform magnetic field. Why is a radial magnetic field employed in the moving coil galvanometer?

CBSE-2020

387. How can you convert a galvanometer into (i) an ammeter and (ii) a voltmeter? Explain with diagrams.

Assam Board-2016

388. A resistance R is connected to a cell of EMF E and has an internal resistance r as shown in the figure. The voltage across R is measured using and ideal voltmeter and circuit current is measured by an ammeter. A rheostat of negligible resistance is used to vary the current in the circuit.



(a) Write down the expression for current in the circuit and voltage across R at any instant.

(b) Draw a graph connecting current in the circuit along X-axis and voltage across R along Y-axis.

(c) The quantity obtained from the slope of the graph is_____.

Kerala Board-2017

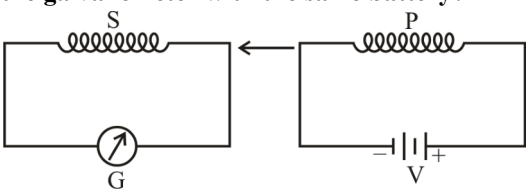
389. Describe the principle and working of a moving-coil galvanometer and hence show that the deflection of the coil is directly proportional to the current flowing through it. What is the effect of the radial magnetic field in a moving - coil galvanometer ?

Meghalaya Board-2019

390. Describe the principle and working of a moving -coil galvanometer. Show that the deflection produced in the coil is directly proportional to the current flowing through it.

Meghalaya Board-2023

290. When primary coil P is moved towards secondary coil S (as shown in the figure below), the galvanometer shows momentary deflection. What can be done to have larger deflection in the galvanometer with the same battery?



(b) State the related law.

CBSE Delhi-2010

391. (i) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

(ii) What it the importance of radial magnetic field and how is it produced?

(iii) Why is it that while using a moving coil galvanometer as a voltmeter, a high resistance in series is required whereas in an ammeter a shunt is used?

CBSE All India-2010

392. (i) Explain giving reasons, the basic difference in converting a galvanometer into (a) a voltmeter and (b) an ammeter.

(ii) Two long straight parallel conductors carrying steady currents I_1 and I_2 are separated by a distance d.

Explain briefly with the help of a suitable diagram, how the magnetic field due to one conductor acts on the other? Hence, deduce the expression for the force acting between the two conductors. Mention the nature of this force.

CBSE All India-2012

393. (i) State using a suitable diagram, the working principle of a moving coil galvanometer. What is the function of a radial magnetic field and the soft iron core used in it?

(ii) For converting a galvanometer into an ammeter, a shunt resistance of small value is used in parallel, whereas in the case of a voltmeter a resistance of large value is used in series. Explain, why?

CBSE Delhi-2014C

394. Explain, using a labelled diagram, the principle and working of a moving coil galvanometer. What is the function of (i) uniform radial magnetic field (ii) soft iron core? Define the terms (i) current sensitivity and (ii) voltage sensitivity of a galvanometer.

Why does increasing the current sensitivity not necessarily increase voltage sensitivity?

CBSE Delhi-2015, CBSE Foreign-2015

395. State the underlying principle of working of a moving coil galvanometer. Write two reasons why a galvanometer cannot be used as such to measure the current in a given circuit. Name any two factors on which the current sensitivity of a galvanometer depends.

CBSE Delhi-2010

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05. Magnetism and Matter

I. Bar Magnet and It's Magnetic Dipole (Along Axis and Perpendicular To Axis Torque On Bar Magnet)

Section-A (Multiple Choice Questions)

1. If the distance between two magnetic poles of pole strength one ampere-metre is 10 cm, then the value of force experienced between them is

(a) $4\pi \times 10^{-5}$ N (b) $4\pi \times 10^{-7}$ N
(c) 10^{-5} N (d) 10^{-5} N

Rajasthan Board-2011

Ans. (c) :

2. Let r be the distance of a point on the axis of a bar magnet from its center. The magnetic field at r is always proportional to

(a) $\frac{1}{r}$
(b) $\frac{1}{r^3}$
(c) $\frac{1}{r^2}$
(d) not necessarily $\frac{1}{r^3}$ at all points

Gujarat Board- May, 2021

Ans. (b) :

3. A straight steel wire of length *l* has magnetic moment m. If the wire is bent in the form of a semicircle, the new value of the magnetic dipole moment is ———.

(a) $\frac{m}{2}$ (b) $\frac{2m}{\pi}$
(c) m (d) $\frac{m}{\pi}$

Gujarat Board- May, 2021

Ans. (b) :

4. A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.15 T experiences a torque of magnitude equal to 4.5×10^{-2} N.m ____ $\frac{Nm}{T}$ is the magnitude of magnetic moment of the magnet.

(a) 0.60 (b) 0.36
(c) 0.45 (d) 0.18

Gujarat Board- August, 2020
Gujarat Board -August ,2020

Ans. (b) :

5. What is the magnitude of the equatorial magnetic field due to a bar magnet of length 5.0 cm and having magnetic dipole moment 0.40 Am^2 at a distance of 50 cm from its mid point?

(a) 0.8×10^{-7}T (b) 6.4×10^{-7}T
(c) 1.6×10^{-7}T (d) 3.2×10^{-7}T

Gujarat Board- August, 2020

Ans. (b) :

6. A bar magnet is of length (size) *l*. The ratio of its equatorial field and axial field for the same distance r (where r >> *l*) is _____.

(a) 0.5 (b) 2
(c) 1 (d) 0

Gujarat Board-March, 2022

Ans. (a) :

7. The magnetic lines of force inside a bar margent

(a) are from N-pole to S-pole of the magnet
(b) are from S-pole to N-pole of the magnet
(c) depends on area of cross-section of bar magnet
(d) do not exist

Jharkhand Board-2023

Ans. (b) :

8. A bar magnet is dropped in a hollow metallic cylinder along its vertical axis. The acceleration of the falling magnet will be :

(a) zero (b) equal to g
(c) less than g (d) greater than g

CBSE-2023

Ans. (a) :

9. The magnetic dipole moment of a current carrying coil does not depend upon

(a) number turns of the coil
(b) cross-sectional area of the coil
(c) current flowing in the coil
(d) material of the turns of the coil

CBSE-2020

Ans. (d) :

10. Two electrons of charge 'e' each move in the same circular path of radius 'r' with a constant speed 'v' each. The magnetic associated with the motion of these electrons is

(a) evr (b) $\frac{evr}{2}$
(c) ev (d) $\frac{4\pi^2r^3e}{v}$

CBSE-2020

Ans. (b) :

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11. A long magnetic needle of length 2L, magnetic moment M and pole strength M units is broken into two at the midpoint. The magnetic moment and pole strength of each piece will be

(a) $\frac{M}{2}, \frac{m}{2}$ (b) $M, \frac{m}{2}$

(c) $\frac{M}{2}, m$ (d) M, m

Meghalaya Board-2014

Ans. (c) :

12. The dimension of magnetic dipole moment is

(a) $ML^{-2}A$ (b) $M^0L^2T^0A$

(c) MLT^0A^2 (d) $[M^0L^1T^1A^1]$

Odisha Board-2022

Ans. (d) :

13. The ratio of the magnetic fields in the end-on and broad side on position of a very short magnet at equidistance from the middle point of the magnet is

(a) 1 : 2 (b) 2 : 1

(c) $1 : \sqrt{2}$ (d) $\sqrt{2} : 1$

Bihar Board-2021

Ans. (b) :

14. Which of the following is correct for work done in the deflection of a magnet in a uniform magnetic field ?

(a) $W = MB(1 - \cos\theta)$ (b) $W = MB(1 - \sin\theta)$

(c) $W = MB(\cos\theta - 1)$ (d) $W = MB(\sin\theta - 1)$

Bihar Board-2021

Ans. (a) :

15. The relation between geometrical length (L_g) and magnetic length (L_m) of a magnet is

(a) $L_m = \frac{5}{6}L_g$ (b) $L_m = \frac{6}{5}L_g$

(c) $L_m = L_g$ (d) $L_m = 2L_g$

Bihar Board-2022

Ans. (a) :

16. The ratio of electric force and gravitational force acting between two charge is in the order of

(a) 10^{42} (b) 10^{39}

(c) 10^{36} (d) 1

Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

17. Magnetic lines form continuous closed loops. Why?

AP Board-2023

18. What is magnetic moment of a bar magnet?

Meghalaya Board-2015

19. Magnetic poles cannot be separated. Comment.

Meghalaya Board-2015

20. Write the four important properties of the magnetic field lines due to a bar magnet.

CBSE-2019

21. State the SI unit of the magnetic moment of a magnet, indicating its direction.

Punjab Board-2018

ISC-2006, 2013

22. Derive an expression for magnetic potential energy $U_m = -\vec{m}.\vec{B}$, for a magnetic dipole kept in a uniform magnetic field.

Gujarat Board- March, 2020

23. When a copper plate is placed below an oscillating magnetic needle the magnetic needle soon stops but if a glass plate is placed below. It does not stop. Give reason.

MP Board-2013

24. If the bar magnet in Q.4 is turned around by 180°, where will the new null points be located ?

ISC-2005

25. A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25T experiences a torque of 4.5×10^{-2} J. What is its magnetic moment?

Assam Board-2017

26. What is the magnitude of the equatorial and axial fields due to a bar magnet of length 5.0 cm at a distance of 50 cm from its mid-point? The magnetic moment of the bar magnet is 0.40 Am^2.

Kerala Board-2020

27. A magnetised needle in uniform magnetic field experiences a torque but no net force. An iron nail near a bar magnet, however, experiences a force of attraction in addition to a torque. Why?

Kerala Board-2020

28. Write two properties of magnetic lines of force.

Karnataka Board-March, 2015

29. Draw the pattern of magnetic fields lines for a bar magnet.

Karnataka Board-March, 2014

Section-C (Short Answer)

30. A bar magnet of dipole moment 3 Am^2 rests with its centre on a frictionless pivot. A force F is applied at right angles to the axis of the magnet, 10 cm from the pivot. It is observed that an external magnetic field of 0.25 T is required to hold the magnet in equilibrium at an angle of 30° with the field.

Calculate the value of F.

How will the equilibrium be effected if F is withdrawn?

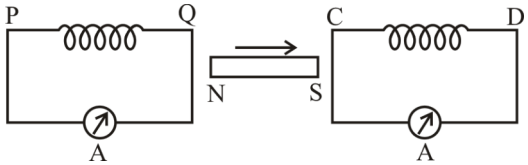
CBSE-2020

31. A small magnet is placed in the magnetic meridian with its S-pole pointing north. The null point is obtained 20 cm away from the center of the magnet. What is the magnetic moment of the magnet if the earth's field is 0.3 $\times 10^{-4}$ T?

Meghalaya Board-2015

Search On TG: @apna_pdf

32. **A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the directions of induced current in each coil.**



CBSE All India-2012

33. **Derive an expression for the magnetic field at a point on the axis located at a distance x from the centre of the magnetic dipole of length 2*l* and magnetic moment M.**

ISC-2006

33. **A small bar magnet is placed in an uniformly external magnetic field of 4.5 Tesla such that its axis is 30° angle from the direction of field. If a torque of 4.5×10^{-2} Newton × metre acts on it, then find the potential energy of the bar magnet.**

UP Board-2020

34. **Define the dipole moment of a magnetic dipole. Write its S. I. unit.**
Obtain the expression for the torque acting on a magnetic dipole placed in an external uniform magnetic field.

CBSE-2019

35. **Does a bar magnet exert a torque on itself due to its own field ? Justify your answer.**

CBSE-2019

36. **When an electron revolves around a nucleus, obtain the expression for the magnetic moment associated with it .**

CBSE-2019

37. **A bar magnet has magnetic moment 2.5 JT^{-1} and is placed in a magnetic field of 0.2 T. Calculate the work done in turning the magnet from parallel to antiparallel position relative to field direction.**

Meghalaya Board-2015

38. **Find an expression for magnetic dipole moment of a revolving electron in an atom.**

Uttarakhand Board-2022

Section-D (Case-Based Questions)

39. **Umesh was a student of class 12th science. He went to visit a science center with his friends. There he saw a magnet oscillating through a string. He observed that oscillation stops when a metal plate is kept under the oscillating magnet. He could not understand the reason. He discussed with his friends that oscillation will continue or stop when magnet is kept under the oscillating metal plate. Next day, they went to their science teacher and became happy to know the reason of the phenomenon.**

(i) Why oscillation stops when a metal plate is kept under the oscillating magnet? Give suitable reason.

(ii) Write two uses and two disadvantages of current produced in the metal plate.

(iii) Write two values each shown by the teacher and Umesh.

Chhattisgarh Board-2023

40. **A small magnetised needle P is placed at the origin of x-y plane with its magnetic moment pointing along the y-axis. Another identical magnetised needle Q is placed in two positions, one by one.**
Case 1 : at (a, 0) with its magnetic moment pointing along x-axis.
Case 2 : at (0, a) with its magnetic moment pointing along y-axis

(a) In which case is the potential energy of P and Q minimum ?

(b) In which case is P and Q not in equilibrium ? Justify your answers.

CBSE-2023

Section-E (Long Answer)

41. **Find the expression for magnetic dipole moment of a revolving electron. What is Bohr magneton?**

CBSE Delhi-2011

42. **(i) Derive the expression for the torque acting on a current carrying loop placed in a magnetic field.**

(ii) Explain the significance of a radial magnetic field when a current carrying coil is kept in it.

CBSE Delhi-2019

43. **Derive an expression for the magnetic dipole moment of an electron revolving around a nucleus.**

Meghalaya Board-2021

44. **Obtain an expression for the torque acting on a rectangular current loop, when placed inclined at an angle θ with the direction of a uniform magnetic field.**

Meghalaya Board-2017

45. **Derive expression for the intensity of magnetic field at a point in end on position due to a short bar magnet.**

Bihar Board-2021
MP Board-2015, 2017

46. **Derive an expression for the intensity of magnetic field on broad side on position due to a bar magnet.**

Bihar Board-2022
MP Board-2012

47. **What is magnetic dipole? Derive an expression for magnetic field intensity at a point on the equatorial line of a bar magnet.**

Punjab Board-2018
MP Board-2015
J&K Board-2011

Search On TG: @apna_pdf

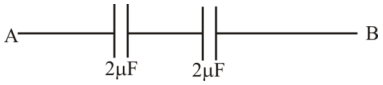
48. Define magnetic dipole moment. Derive and expression for magnetic field intensity at a point an axial line of a bar magnet.

J&K Board-2016, 2018

49. Derive an expression for the electric potential due to a point charge. A positive charge of magnitude 6μ c is placed in a dielectric medium of dialectic constant 2. What is the electric potential at a point in the deictic medium at a distance of 10 cm form the charge?

Or

Derive an expression for the energy stored in a parallel plate capacitor and express it in two more forms.



The figure shown tow air filled capacitors of capacitance 2μ F each connected in series. What will be the equivalent capacitance across A B if dielectric slabs of dielectric constant 3 are introduced between the plates of both the capacitors filling the space between the plates completely?

Goa Board-2018

50. A bar magnet of magnetic moment 'm' is allowed to oscillate freely in an external uniform magnetic field of strength B.

(a) If the strength of the magnetic field is doubled, keeping it uniform, what will be the effect on

(1) The time period of oscillations of the magnet ?

(1) The torque acting on the magnet ?

(b) An external torque is applied to rotale the bar magnet form a position in which the magnetic dipole moment is parallel to the magnetic field to a position in which it is perpendicular to the field. What will be the change in potential energy of the magnet?

Goa Board-2018

51. Derive an expression for the torque on a rectangular current carrying loop suspended in a uniform magnetic field.

Manipur Board-2022

52. Derive an expression for potential energy of a magnetic dipole when placed in uniform magnetic field. When does the magnetic dipole posses maximum potential energy inside a magnetic field?

Manipur Board-2022

II. Magnetism and Gauss's Law

Section-A (Multiple Choice Questions)

53. In earth's magnetic field B_H, if the frequency of any magnetic needle is n, then

(a) $n \propto B_H$ (b) $n^2 \propto B_H$

(c) $n \propto B_H^2$ (d) $n^2 \propto \frac{1}{B_H}$

Bihar Board-2022, 2019

Ans. (b) :

54. Magnetic moment of the earth is

(a) $8.0\ JT^{-1}$ (b) $11.5\ JT^{-1}$

(c) πJT^{-1} (d) $8.0 \times 10^{22}\ JT^{-1}$

Bihar Board-2023

Ans. (d) :

55. The angle between magnetic meridian and geographical meridian is called

(a) angle of dip

(b) declination

(c) horizontal component of magnetic field

(d) apparent angle of dip

Bihar Board-2023

Ans. (b) :

56. Angle of dip at earth's magnetic pole is

(a) 0° (b) 90°

(c) 45° (d) 180°

Odisha Board-2022

Bihar Board-2019, 2021, 2022

Kerala Board-2017

MP Board-2015

Ans. (b) :

57. A jet plane is travelling towers west at a speed of 500 ms^{-1}. What is the voltage difference developed between the ends of the wing having a span of 25m. If the Earth's vertical magnetic field component at a location has a magnitude of 2.5×10^{-4} T and the dip angle is 30º

(a) 1.562 mV (b) 3.125 mV

(c) 2.562 mV (d) 4.125 mV

Gujarat Board- August, 2020

Ans. (b) :

58. The vertical component of earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component. The value of angle of dip at this place is

(a) 30° (b) 45°

(c) 60° (d) 90°

Jharkhand Board-2023

Ans. (c) :

Section-B (Very Short Answer)

59. Write the name of magnetic elements of earth and also define them.

Uttarakhand Board-2019

60. The horizontal component of earth's magnetic field at any place is $\sqrt{3}$ times its vertical component. What will be the value of angle of dip at that place ?

Bihar Board-2023

Gujarat Board -2020

Gujarat Board- May, 2021

61. Define magnetic inclination or angle of dip.

Telangana Board-2015

Karnataka Board-March, 2014, 2017

Karnataka Board-July, 2015

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62. What is the change in the value of angle of dip when one goes from the equator to the north pole of earth ?

CBSE-2020

63. Classify the following materials with regard to magnetism: Manganese, Cobalt, Bismuth, Copper.

AP Board-2020

Telangana Board-2015

64. What is maximum value of angle of dip? At what places does it occur?

J&K Board-2023

65. The magnetic field and angel of dip at a place on the earth are 0.3 G and 30º respectively. The value of vertical component of the earth's magnetic field at the place is ____.

CBSE-2020

66. A magnetic needle free to rotate in a vertical plane orients itself vertically at a certain place on earth. The value of angle of dip at this place is _____.

CBSE-2020

66. The vertical plane containing the longitudinal circle and the axis of rotation of the Earth is called the …… meridian.

Haryana Board-2022

68. At a particular place the horizontal and vertical components of earth's magnetic field are found to equal. What is the value of dip at this place?

Kerala Board-2021

69. The earth's magnetic field at the equator is approximately 4×10^{-5} T. Estimate the earth's dipole moment. (Radius of the earth = 6.4×10^{6} m)

AP Board-2021

70. Define the terms:
(i) Declination
(ii) Inclination or Dip

Karnataka Board-March, 2014, 2017

Karnataka Board-July, 2015

71. What is the angle of dip at a place where the horizontal and vertical components of the earth's magnetic field are equal ?

ISC-2007

72. Does every magnetic configuration necessarily have a north pole and a south pole ? What about the field due to a toroid ?

Nagaland Board-2021

73. Write one possible cause of earth's magnetism

Nagaland Board-2021

74. A straight wire of mass 200 g and length 1.5m carries a current of 2A. It is suspended in mid air by a uniform horizontal magnetic field $\vec{B}$. Find the magnitude of $\vec{B}$.

Nagaland Board-2021

75. For the terrestrial magnetism establish a relation between angle of dip θ horizontal component H and vertical component V.

MP Board-2012

76. Horizontal and vertical components of earth's magnetic field at a place are 0.22 tesla and 0.38 tesla respectively. Find the resultant intensity of earth's magnetic field at the place.

Meghalaya Board-2018

77. Define declination.

Karnataka Board-July, 2019

78. Where on the earth's surface is the magnetic dip zero?

Karnataka Board-July, 2018

Karnataka Board-July, 2016

Section-C (Short Answer)

79. On suspending a magnet at 30° with magnetic meridian, it makes an angle of 45° with the horizontal. What will be the actual angle of dip?

UP Board-2023

80. Answer the following giving reasons :
(a) Do the magnetic field lines also represent the 'lines of force' on a moving charged particle at every point ?
(b) If magnetic monopoles existed, how would the Gauss's law of magnetism be modified?

CBSE-2023

81. What are the elements of earth terrestrial magnetism ? Derive the relation among them.

UP Board-2018

82. Define angle of magnetic inclination or dip at a place. Write the expression for earth's magnetic field.

Nagaland Board-2021

83. What Are?
i. Magnetic declination
ii. Magnetic dip
iii. Horizontal component of earth's magnetic field at a place?

Karnataka Board- March, 2014

84. A magnetic needle oscillates in a uniform magnetic field of strength B_1 with a time period of 10 second. The same magnetic needle oscillates in another uniform magnetic field strength B_2 with a time period 20 seconds. Which magnetic field is strong, B_1 or B_2 ? Why?

Kerala Board-2017

85. The horizontal component of the earth's magnetic field at a place is B and angle of dip is 60°. What is the value of vertical component of the earth's magnetic field at equator ?

ISC-2008

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86. **The horizontal component of the earth's magnetic field at a place is $\sqrt{3}$ times its vertical component there. Find the value of the angle of dip at that place. What is the ratio of the horizontal component to the total magnetic field of the earth at that place ?**

ISC-2001

87. **A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its North tip down at 60° with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.4G. Determine the magnitude of the earth's magnetic field at the place.**

ISC-2004

88. **Prove that:**

$I^2 = H^2 + V^2$ and $\tan\theta = \frac{V}{H}$, where for terrestrial magnetism θ angle of dip, H horizontal component and V vertical component.

MP Board-2014

89. **What is angle of dip? Establish the relationship between horizontal component H of the earth, the vertical component V and resultant intensity I at a place.**

Chhattisgarh Board-2022

90. **From separate magnet method of vibrational magnetometer, describe the method of comparison of magnetic moment of two magnets under the following points :**

(i) Derivation of the formula
(ii) Observation table
(iii) Two precautions

Chhattisgarh Board-2018

91. **What are the different components of earth's magnetism ? Define them.**

UP Board-2019, 2021, 2022

92. **State and explain Gauss law in magnetism.**

Karnataka Board-July, 2016, 2019

93. **Define:**
a) Magnetic declination
b) Magnetic dip Mention the
S.I unit of magnetization.

Karnataka Board-July, 2015

Section-D (Case-Based Questions)

94. **Vandana was a student of Class 12th Science. She went to visit a science center with her friends. There, she saw a magnet oscillating through a string. She observed that oscillation stops when a metal plate is kept under the oscillating magnet. She could not understand the reason. She discussed with her friends that oscillation will continue or stop when magnet is kept under the oscillating will continue or stop when magnet is kept under the oscillating metal plate. Next day, they went to their science teacher and became happy to know the reason of the phenomenon.**

(i) Why oscillation stops when a metal plate is kept under the oscillating magnet? Give suitable reason.
(ii) Write two properties of current produced in the metal plate. How we can reduce this current? Write.
(iii) Write two values each shown by the teacher and Vandana.

Chhattisgarh Board-2019

Section-E (Long Answer)

95. **What is meant by angle of dip ?**

(a) A magnetic needle free to rotate in vertical plane is taken to a magnetic pole of the earth. How will it orient it self?
(b) When a magnetic needle free to rotate in horizontal plane is taken to a magnetic pole of the Earth, it is unable to show the magnetic directions and orient itself in any direction. Why?

Goa Board-2023

96. **A short magnet placed in a horizontal plane has its axis aligned along the magnetic North-South direction. Null points are found on the axis of the magnet at 14 cm from the centre of the magnet. The earth's magnetic field at the place is 0.36 gauss and the angle of dip is zero. What is the total magnetic field on the normal bisector of the magnet at the same distance as the null point (i.e.14cm) from the centre of the magnet ? (At null points, field due to a magnet is equal and opposite to the horizontal component of the earth's magnetic field.**

ISC-2000

III. Magnetic Property of Materials (Para, Dia and Ferro-Magnetic)

Section-A (Multiple Choice Questions)

97. **The material of a permanent magnet should have**

(a) high retentivity and low coercivity
(b) low retentivity and high coercivity
(c) low retentivity and low coercivity
(d) high retentivity and high coercivity

Nagaland Board-2018

Ans. (b) :

98. **The horizontal component of earth's magnetic field at a place is 3 times the vertical component. The value of the dip at this place is**

(a) 60° (b) 90°
(c) 0° (d) 30°

Meghalaya Board-2014

Ans. (d) :

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99. Ferromagnetic materials are having_____ retentivity and ____permeability. (For electromagnetic core)
(a) High, Low (b) Low, High
(c) High, High (d) Low, Low
Gujarat Board- August, 2020, 2023

Ans. (b) :

100. Superconductors are one type of _____substances.
(a) Diamagnetic (b) Ferromagnetic
(c) Paramagnetic (d) Non-magnetic
Gujarat Board- July, 2022

Ans. (a) :

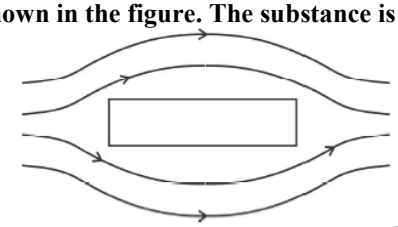
101. In which material domains are formed ?
(a) Diamagnetic (b) Paramagnetic
(c) Ferromagnetic (d) In all of these
UP Board-2019

Ans. (c) :

102. Which of the following has its permeability less than that of free space?
(a) Copper (b) Aluminium
(c) Copper chloride (d) Nickel
CBSE-2023

Ans. (b) :

103. The magnetic field lines near a substance are as shown in the figure. The substance is :



(a) Copper (b) Iron
(c) Sodium (d) Aluminium
CBSE-2023

Ans. (a) :

104. Assertion (A) : Diamagnetic substances exhibit magnetism.
Reason (R) : Diamagnetic materials do not have permanent magnetic dipole moment.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, and Reason (R) is NOT the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.
CBSE-2023

Ans. (c) :

105. A diamagnetic substance is brought near the north or south pole of a bar magnet. It will be :
(a) repelled by both the poles.
(b) attracted by both the poles.
(c) repelled by the north pole and attracted by the south pole.
(d) attracted by the north pole and repelled by the south pole.
CBSE-2023

Ans. (a) :

106. The material which is not suitable for making a permanent magnet is
(a) Steel (b) Ticonal
(c) Lead (d) Alnico
CBSE-2020

Ans. (c) :

107. Above Curie temperature, a
(a) ferromagnetic material becomes diamagnetic.
(b) ferromagnetic material becomes paramagnetic.
(c) paramagnetic material becomes ferromagnetic.
(d) paramagnetic material becomes diamagnetic.
CBSE-2020

Ans. (b) :

108. Cobalt and Nickel are –
(a) Diamagnetic Substance
(b) Paramagnetic Substance
(c) Ferromagnetic Substance
(d) None of these
Uttarakhand Board-2020

Ans. (c) :

109. Water is
(a) diamagnetic material
(b) paramagnetic material
(c) ferromagnetic material
(d) not a magnetic material
Bihar Board-2021

Ans. (a) :

110. The susceptibility of paramagnetic substance
(a) is constant
(b) is zero
(c) is infinity
(d) depends on magnetic field
Bihar Board-2022
Bihar Board-2019

Ans. (a) :

111. Nickel is
(a) paramagnetic (b) diamagnetic
(c) ferromagnetic (d) none of these
Bihar Board-2022, 2023

Ans. (c) :

112. The angle between magnetic meridian and geographical meridian is called
(a) angle of dip
(b) declination
(c) horizontal component of magnetic field
(d) apparent angle of dip
Bihar Board-2022

Ans. (b) :

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Section-B (Very Short Answer)

113. What is Curie law ?

Bihar Board-2023

114. The magnetic field lines are ____ by a paramagnetic substance.

CBSE-2020

115. Write any two points of difference between a diamagnetic and a paramagnetic substance.

CBSE-2023

116. Select two paramagnetic material from the following:
Sodium (Na), Bismuth (Bi), Copper (Cu), Aluminum (Al), Lead (Pb)

Rajasthan Board-2023

117. What is hysteresis? Mention the significance of hysteresis curve.

Karnataka Board-July, 2020

118. What are diamagnetic substances?

Punjab Board-2018

119. State and explain Curie's law for paramagnetic materials and explain saturation magnetization for paramagnetic materials.

Gujarat Board- March, 2019

120. Define diamagnetic and paramagnetic materials.

Jharkhand Board-2020
Punjab Board-2018

121. What are paramagnetic substances? How does its magnetic susceptibility vary with temperature?

Jharkhand Board-2019

122. The resultant magnetic moment of diamagnetic and paramagnetic substance are zero and finite respectively. Why ?

UP Board-2018

123. (i) Explain the term hysteresis.
(ii) Name three elements of the earth's magnetic field which help in defining earth's magnetic field completely.

ISC-2015

124. Distinguish between diamagnetic and paramagnetic substances in terms of its relative permeability (μ_r) and magnetic susceptibility (χ).

ISC-2005

125. At a certain temperature, a ferromagnetic material becomes paramagnetic. What is the temperature called ?

ISC-2014

126. Do the diamagnetic substances have resultant magnetic moment in an atom in the absence of external magnetic field?

CBSE-2019

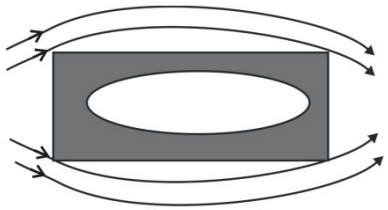
127. What are hard ferromagnetic and soft ferromagnetic materials? Give one example of each. 1+1 = 2

Assam Board-2013

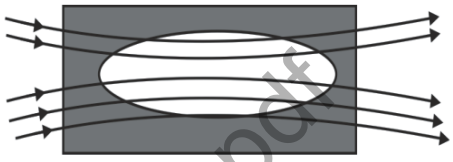
128. What is Curie temperature of a ferromagnetic material? Give one example of a ferromagnetic material.

Assam Board-2013

129. The behavior of magnetic field lines two magnetic substances P and Q are shown below.



Substance P



Substance Q

(a) From the figure identify paramagnetic substance.
(b) Susceptibility of substance P is ..... . (positive/negative)

Kerala Board-2021

130. What happens to a ferromagnetic substance heated above Curie temperature?

Maharashtra Board-2019

131. State two properties of Paramagnetic substance

J&K Board-2021
CBSE-2019

132. Define "retentivity" and "coercivity".

Karnataka Board-March, 2020
Karnataka Board-July, 2015, 2018

133. Distinguish between paramagnetic and ferromagnetic substances.

Karnataka Board-July, 2016

134. Write two properties of diamagnetic substance.

Bihar Board-2022
Karnataka Board-March, 2015

Section-C (Short Answer)

135. Write any four properties of ferromagnetic materials and give an example for it.

Karnataka Board-March, 2014, 2016, 2017
Karnataka Board-July, 2014

136. Earth behaves as a magnet with magnetic poles approximately near the geographic poles.
(a) The order of magnitude of earth's magnetic field in tesla is _____
(b) What do you understand by 'dynamo effect' ?
(c) Classify the following materials into diamagnetic and paramagnetic

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(i) Lead
(ii) Magnesium
(iii) Tungsten
(iv) Copper

Kerala Board-2013

137. What are diamagnetic, paramagnetic and ferromagnetic substances? give their properties.

J&K Board-2022

138. Two identical bars, one of paramagnetic material and other of diamagnetic material are kept in a uniform external magnetic field parallel to it. Draw diagrammatically the modifications in the magnetic field pattern in each case.

CBSE-2020

139. State and explain 'Curie's Law' in magnetism.

Karnataka Board-July, 2016, 2018

140. How do dia- and ferro-magnetic materials behave when kept in a uniform external (magnetic) field? Give one example of each of these materials.

NIOS-2015

141. What are the paramagnetic, diamagnetic and ferromagnetic substances ? Justify your answer.

UP Board-2020

142. (i) What is meant by a paramagnetic substance ? State Curie's law
(ii) What is the value of magnetic susceptibility of aluminium, if its relative permeability is 1.000022 ?

ISC-2011

143. Draw a hysteresis loop with axis labeled and showing retentive and coercive force. What does the area of the loop represent ?

ISC-2002

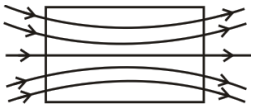
144. Two substances A and B have their relative magnetic permeabilities slightly greater than and less than unity, respectively. What do you conclude about the magnetic nature of A and B (dia, para or ferromagnetic) ? Draw a labelled sketch of a hysteresis loop.

ISC-2001

145. Write three points of differences between para-, dia-and ferro- magnetic materials, giving one example for each.

MP Board-2021
J&K Board-2020
CBSE-2019
Assam Board-2014

146. Depending on the magnetic property, the materials are classified in to diamagnetic, paramagnetic and ferro magnetic.
(a) The behaviour of magnetic field lines near a magnetic substance is shown in the figure. Which material corresponds to the figure.
(b) State and explain Curie's law.
(c) Compare paramagnetism and Ferro magnetism. Give examples of each.



Kerala Board-2014

147. What are Diamagnetic Substances? Give properties of diamagnetic substances.

Haryana Board-2016
J&K Board-2011

148. Mention three differences between diamagnetic and paramagnetic sub-stances.

Odisha Board-2020, 2023

154. Distinguish between 'dia' and 'ferro' magnetic materials.

Karnataka Board-March, 2019

149. What is hysterisis? Define the terms coercivity and 'retentivity' of a ferromagnetic material.

Karnataka Board-July, 2018

150. Write any three distinguishing properties between diamagnetic and ferromagnetic materials.

Karnataka Board-July, 2019
Karnataka Board-March, 2019

151. Write three differences between diamagnetic and paramagnetic substances.

Karnataka Board-July, 2018
Karnataka Board-March, 2015

Section-D (Long Answer)

152. Magnetic materials are broadly classified as diamagnetic, paramagnetic and ferromagnetic.
(a) Mention the behavior of dia and ferromagnetic materials when they are placed in a non – uniform magnetic field.

(b) The temperature at which a ferromagnetic material becomes paramagnetic is
(i) Transition temperature
(ii) Critical temperature
(i) Curie temperature
(ii) Triple point

Kerala Board-2016

IV. Magnetisation. (Susceptibility and Relative Permeability)

Section-A (Multiple Choice Questions)

153. The product of permeability of free space and permittivity is–
(a) c (b) c^{-1}
(c) c^2 (d) c^{-2}

Assam Board-2017

Ans. (d) :

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154. Which one of the following has negative value of susceptibility ?
(a) Nickel (b) Aluminium
(c) Lead (d) Iron
CBSE-2023

Ans. (c) :

155. If μ_0 and ε_0 are respectively the permeability and permittivity of free space, μ and ε are the corresponding quantities in a medium, then the refractive index of the medium with respect to free space is :
(a) $\sqrt{\mu_0\varepsilon_0}$ (b) $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$
(c) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$ (d) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$
Tamil Nadu Board-2018

Ans. (b) :

156. Magnetic induction at a distance a from an infinitely long straight conductor carrying a current *I* and placed in a medium of permeability μ is
(a) $\frac{\mu_0 I}{4\pi a}$ (b) $\frac{\mu_0 I}{2\pi a}$
(c) $\frac{\mu I}{4\pi a}$ (d) $\frac{\mu I}{2\pi a}$
Tamil Nadu Board-2011

Ans. (b) :

157. The correct relationship between the permittivity of free space ($\in_0$), the permeability of free space (μ_0) and the velocity of light in vacuum (c) is–
(a) $\mu_0 \in_0 = c^2$
(b) $\frac{1}{\mu_0 \in_0} = c^2$
(c) $\sqrt{\mu_0 \in_0} = c^2$
(d) $\frac{1}{\sqrt{\mu_0 \in_0}} = c^2$
Rajasthan Board-2022

Ans. (b) :

158. Magnetic susceptibility of a paramagnetic substance is:
(a) small and positive (b) small and negative
(c) large and positive (d) large and negative
Haryana Board-2017

Ans. (a) :

159. Magnetization for vacuum is ———.
(a) Infinite (b) Positive
(c) Negative (d) Zero
Gujarat Board- May, 2021

Ans. (b) :

160. Meissner effect is observed in —— substances.
(a) Paramagnetic
(b) Ferromagnetic
(c) Superconducting
(d) Permanent magnetic
Gujarat Board- March, 2020

Ans. (c) :

161. Experimentally, one finds that the magnetisation of a paramagnetic material is _____ proportional to applied magnetic field and _____proportional to the absolute temperature.
(a) Directly, inversely (b) Inversely, inversely
(c) Directly, directly (d) Inversely, directly
Gujarat Board-March, 2022

Ans. (d) :

162. The unit of magnetisation (M) is _____.
(a) Am^{-1} (b) Am^{-2}
(c) Cm^{-1} (d) Cm^{-2}
Gujarat Board- July, 2022

Ans. (a) :

163. Magnetic susceptibility of platinum is 0.0001. Its relative permeability is
(a) 1.0000 (b) 0.9999
(c) 1.0001 (d) 0.
Jharkhand Board-2018
ISC-2017

Ans. (c) :

164. Magnetic susceptibility for diamagnetic materials is
(a) small and negative (b) small and positive
(c) large and positive (d) large and negative
Meghalaya Board-2015

Ans. (a) :

165. The SI unit of magnetic permeability is
(a) T m/A (b) Tm^2/A
(c) TA/m (d) TA/m^2
Odisha Board-2022

Ans. (a) :

Section-B (Very Short Answer)

166. Name the two factors affecting the magnetism of electromagnet.
Uttarakhand Board-2019

167. Write two characteristics of a material to produce a permanent magnet.
Rajasthan Board-2023

168. Distinguish between diamagnetism and ferromagnetism on the basis of relative permeability and susceptibility.
Karnataka Board-July, 2015

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169. Define : (1) Magnetization and (2) Magnetic intensity.

Maharashtra Board-2015

170. What is electric polarization vector? Define the electric susceptibility.

Assam Board-2014

171. Two materials X and Y are magnetised whose intensity of magnetisation are 500 Am^{-1} and 2000 Am^{-1} respectively. The magnetizing field is 1000 Am^{-1}. What is the ratio between the susceptibilities of the two material?

Tamil Nadu Board-2023

172. Define the term declination, dip and horizontal component

CBSE-2020
Karnataka Board-July, 2018
Nagaland Board-2018
Karnataka Board-March, 2014, 2015
J&K Board-2014, 15

173. What are magnetic lines of force? Why two such lines do not cross each other?

J&K Board-2023

174. Define the term magnetic susceptibility x and write its unit.

Karnataka Board-March, 2019
Haryana Board-2018

175. Magnetic susceptibility of ferromagnetic substance is …. .

Haryana Board-2016

176. Define magnetization (M). Write its formula, unit and dimension.

Gujarat Board- July, 2022
Haryana Board-2018
Maharastra Board-2018
Karnataka Board-March, 2016

177. Establish the relation between Magnetic permeability and Magnetic susceptibility.

Jharkhand Board-2023

178. Arrange the three type of magnetic materials i.e. paramagnetic, diamagnetic and ferromagnetic materials, in decreasing order of their magnetic susceptibility.

ISC-2010, 2003

179. State how the magnetic susceptibility of a ferromagnetic material changes when it is heated.

ISC-2009

180. (i) Define Curie temperature.
(ii) If magnetic susceptibility of a certain magnetic material is 0.0001, find its relative permeability

ISC-2016

181. State how magnetic susceptibility is different for the three types of magnetic materials, i.e. diamagnetic, paramagnetic and ferromagnetic materials.

ISC-2015

182. Two substances A and B have their relative permeabilities slightly greater and slightly less than 1 respectively. What do you conclude about A and B as far their magnetic materials are concerned ?

ISC-2014

183. The magnetic susceptibility of magnesium at 300 K is 1.2×10^5. At what temperature will its magnetic susceptibility become 1.44×10^5 ?

CBSE-2019

184. The magnetic susceptibility x of a given material is – 0.5. Identify the magnetic material.

CBSE-2019

185. The susceptibility of magnesium at 300K is 1.2×10^{-15}. What will be its susceptibility at 200 K?

Maharashtra Board-2019

186. Define magnetic 'dip' and 'declination' at a place.

Karnataka Board-March, 2019
Jharkhand Board-2018
AP Board-2013

187. Draw the variation of magnetic field (B) with magnetic intensity (H) when a ferromagnetic material is subjected to a cycle of magnetization.

Karnataka Board-March, 2016

188. What is magnetic susceptibility? For which material is it low and positive?

Karnataka Board-March, 2014

Section-C (Short Answer)

189. Write the expression for the speed of light in a material medium of relative permittivity ε_r and relative magnetic permeability μ_r

CBSE-2020

190. What is magnetization, magnetic intensity and magnetic susceptibility?

Maharashtra Board-2022, 2023

Section-D (Long Answer)

191. (a) What do you understand by Permanent Magnets and Electromagnet? Give uses of Electromagnet.

(b) A solenoid has a core of a material with relative permeability 400. The windings of the solenoli are insulated from the core and carry a current of 2A. If the number of turns is 1000 per meter, calculate the magnetic intensity (H) and magnetic field (B).

Uttarakhand Board-2020

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06. Electromagnetic Induction

I. Electromagnetic Induction and Faraday's Law

Section-A (Multiple Choice Questions)

1. Eddy currents are used in-
(a) Magnetic braking in trains
(b) Induction furnace
(c) Electromagnetic damping
(d) All of the above

Rajasthan Board-2022

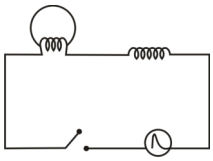
Ans. (d) :

2. The electromagnetic damping is due to _____.
(a) Displacement currents
(b) Conduction currents
(c) Eddy currents
(d) None of the given choices

Gujarat Board- July, 2022

Ans. (c) :

3. A light bulb and an open coil inductor are connected to an ac source through a key as shown in figure. The switch is closed and after some time. an iron rod is inserted in to the interior of the inductor. The glow of the light bulb____.



(a) Unchanged (b) Decrease
(c) Increase (d) Increase and Decrease

Uttarakhand Board, 2020
Gujarat Board- August, 2020

Ans. (b) :

4. Electromagnetic induction is not used in:
(a) transformer (b) room heater
(c) AC generator (d) choke coil

Tamil Nadu Board-March, 2016

Ans. (b) :

5. The direction of induced emf is given by :
(a) Ohm's law (b) Faraday law
(c) Lenz's law (d) None

Haryana Board-2016

Ans. (c) :

6. Faraday's law gives _____ of induced emf.
(a) Only magnitude
(b) Only direction
(c) Both magnitude and direction
(d) None of the above

Gujarat Board-March, 2022

Ans. (a) :

7. In an a.c generator
(a) mechanical energy is electrical energy
(b) electrical energy is converted into mechanical energy
(c) electrical energy is converted into heat energy
(d) None of the above

Meghalaya Board-2014

Ans. (a) :

8. Eddy currents are used in :
(a) electrolysis
(b) making a galvanometer dead beat
(c) electroplating
(d) to increase the sensitivity of galvanometer

MP Board-2014

Ans. (b) :

Section-B (Very Short Answer)

9. What is the reason for the formation of eddy currents? State any one use of it.

Uttarakhand Board-2023

10. Deduce an equation $U = \frac{1}{2}LI^2$ for an inductor.

Gujarat Board- May, 2021
Gujarat Board- March, 2019

11. What are eddy currents? Give its two applications.

Uttarakhand Board-2019
Haryana Board-2016
Assam Board-2016
CBSE All India-2012
Kerala Board-2017

12. What are eddy currents and how can they be minimised ?

Meghalaya Board-2021

13. At which position of the plane of the rotating coil with the direction of magnetic field, the e.m.f. induced in the coil is maximum?

Maharashtra Board-2019

14. Describe the ways in which Eddy currents are used to advantage.

Telangana Board-2015, 2018

15. What are Eddy currents ? How are these produced ?

Nagaland Board-2017

16. Define Tesla.

J&K Board-2014, 2015

17. When a metal rod of length *l* is placed normal to a uniform magnetic field B and moved with a velocity v, perpendicular to the field, the induced emf (called motional emf) across its end is …….

Haryana Board-2022

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18. The mass of a substance liberated at any electrode according to the Faraday's first law of electrolysis is directly proportional to _____ in the solution.

Chhattisgarh Board-2018

19. State and verify Faraday's second law of electrolysis through an experiment.

Tamil Nadu Board-September, 2016

20. What is electromagnetic induction?

Tamil Nadu Board-September, 2016

21. Calculate the magnetic induction at a point 10cm from a long straight wire placed in air carrying a current of 10A.

Tamil Nadu Board-March, 2016

22. State Faradays laws of electrolysis.

Tamil Nadu Board-2015

23. Write statement for electromagnetic induction.
(i) Faraday's law
(ii) Lenz's law

Rajasthan Board-2023

24. Write Faraday's law of electromagnetic induction.

Rajasthan Board-2022

25. State Faraday's laws of electromagnetic induction.

Bihar Board-2022
Haryana Board-2017
NIOS-2019
Karnataka Board-2018
Karnataka Board-March, 2016
Karnataka Board-July, 2014
CBSE Foreign-2012

26. Write four points for electric dipole and magnetic dipole analogy.

Gujarat Board- August, 2020

27. Write Faraday's laws of electromagnetic induction and obtain an expression of induced e.m.f.

MP Board-2015

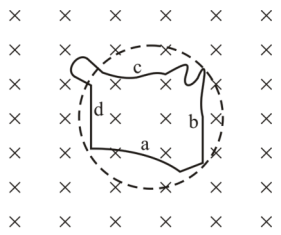
28. Write Faraday's second law of electromagnetic induction.

MP Board-2022
Chhattisgarh Board-2022

29. The energy stored in a solenoid of inductance L is U. The number of turns per unit length of the solenoid is doubled. Keeping the current and all other factors same, find (a) changes in inductance of the solenoid, and (b) the finale energy stored in the inductor.

CBSE-2020

30. A flexible wire of irregular shape, abcd as shown in the figure, turns into a circular shape when placed in a magnetic field which is directed normal to the plane of the loop away from the reader. Predict the direction of the induced current in the wire.



CBSE Foreign-2014

31. Give any one use of electromagnet.

Karnataka Board-March, 2020

32. Write any one advantage of Eddy current.

Karnataka Board-July, 2019, 2020

33. What are eddy currents? Give one use of eddy currents.

Bihar Board-2022
Karnataka Board-July, 2014, 2015

28. What are eddy currents? Give one use of it.

Karnataka Board-July, 2014, 2015

34. Mention –any two advantages of eddy currents in practical applications.

Karnataka Board-March, 2014

35. What are the S.I. Units of magnetic moment and magnetic induction?

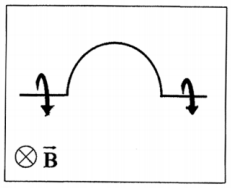
AP Board-2022

36. Describe the ways in which Eddy currents are used to advantage.

AP Board-2023

Section-C (Short Answer)

37. A stiff wire is bent into a semicircle of radius $\left(\frac{1}{\pi}\right)$m as shown in the figure. It is rotated about its diameter with 30 rev/s in a uniform magnetic field of 20×10^{-3}T. Calculate the maximum value of e.m.f induced in the loop:



Goa Board-2023

38. State and explain Faraday's law of electromagnetic induction.

J&K Board-2020, 2021, 2022
Haryana Board-2018
Karnataka Board-March, 2017

39. Explain any one advantage of using eddy current in (a) magnetic braking in trains, (b) electromagnetic damping, and (c) induction furnace.

Assam Board-2023

40. What are eddy currents? Explain with experimental deomonstration.

MP Board-2017

Search On TG: @apna_pdf

41. (a) State Faraday's law of electromagnetic induction. Write its mathematical form.
(b) Name the factors on which the inductance of a coil depends.

Kerala Board-2016

42. State Faraday's first law of electrolysis. How is it verified experimentally?

Tamil Nadu Board-March, 2016

43. What are Faraday's laws of electromagnetic induction ?

Haryana Board-2016

44. A metal rod of length L meter rotates about one end in a vertical plane at right angles to the magnetic meridian. Frequency of revolution is *f* Hz. If the Horizontal component of Earth's magnetic field is H Tesla then find the expression of induced emf between the ends of the rod.

Assam Board-2015

45. Define the following:
(i) Magnetic Dipole
(ii) Bohr Magneton
(iii) Magnetic Field Lines

Chhattisgarh Board-2021

46. State and explain laws of electromagnetic induction.

Odisha Board-2023
UP Board-2018

47. State Faraday's laws of electromagnetic induction.
The flux of magnetic field changes with time according to the equation $\phi = at^2 + bt + c$ weber.
(i) Find the unit of a b, and c.
(ii) If a = 0.3, b = 0.6 and c = 0.8 unit, then calculate induced electromagnetic force at t = 2 sec.

UP Board-2020

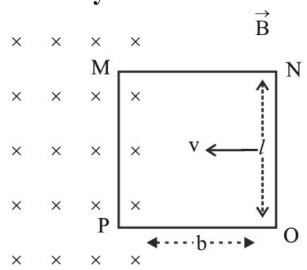
48. (a) How are eddy currents generated in a conductor which is subjected to a magnetic field ?
(b) Write two examples of their useful applications.
(c) How can the disadvantages of eddy currents be minimized ?

CBSE-2019

49. (b) A circular coil of radius 10 cm and 20 turns is rotated about its vertical diameter with angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of 3.0×10^{-2} T.
(i) Calculate the maximum and average emf induced in the coil.
(ii) If the coil forms a closed loop of resistance 10 Ω, calculate the maximum current in the coil and the average power loss due to Joule heating.

CBSE-2019

50. The figure shows a rectangular conducting frame MNOP of resistance R placed partly in a perpendicular magnetic field $\vec{B}$ and moved with velocity $\vec{v}$ as shown in the figure.



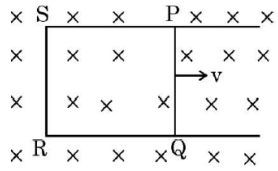
Obtain the expressions for the
(a) force acting on the arm 'ON' and its direction, and
(b) power required to move the frame to get a steady emf induced between the arms MN and PO.

CBSE-2019

51. A rectangular loop of sides 25 cm and 20 cm is lying in x-y plane. It is subjected to a magnetic field $\vec{B} = (5t^2 + 2t + 10)\hat{k}$, where B is in Tesla and t is in seconds. If the resistance of the loop is 4Ω , find the emf induced and the induced current in the loop at t = 5 s.

CBSE-2023

52. The figure shows a rectangular conductor PQRS in which the arm PQ of length 10 cm and resistance 0.4 Ωis free to move. It is kept in a uniform magnetic field B = 0.2 T acting perpendicular into the plane of PQRS. If arm PQ is moved with a velocity v of 5 cm/s as shown, find :



(a) the current induced in the loop, and
(b) the power required to move the arm.
(Resistances of arms PS, SR and RQ are negligible.)

CBSE-2023

53. A thin dielectric disc uniformly distributed with charge q has radius r and is rotated n times per second about an axis perpendicular to the disc and passing through the centre. Find the magnetic induction at the centre of the disc.

Assam Board-2016

54. A coil of area A, number of turns N and resistance R is rotating in a radial magnetic field B with an angular speed w. What is the maximum power consumed by the coil? 3

Assam Board-2015

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55. Mention any two useful applications of eddy currents.

ISC-2009

56. (a) State Faraday's law of electromagnetic induction.
(b) How does the magnetic energy stored in an inductor and electrostatic energy stored in a capacitor related to their respective field strengths?

Kerala Board-2020

57. Explain briefly the coil and magnet experiment to demonstrate electromagnetic induction.

Karnataka Board-March, 2016

58. Describe the coil and barmaget experiment to demonstrate the phenomenon of electromagnetic induction.

Karnataka Board-July, 2018, 2020

59. Explain the construction of transformer. Mention its principle.

Karnataka Board- March, 2014

60. A square loop of a conducting material of side *l* and resistance r is dragged through a uniform magnetic field B with uniform velocity v keeping the plane of the loop perpendicular to the direction of the field. What is the current flowing through the loop?

Assam Board-2017

Section-D (Long Answer)

61. Obtain the expression for the induced emf by changing relative orientation of the coil with the magnetic field (Graph not necessary).

Tamil Nadu Board-2023

62. What are Eddy currents? How do they arise? Write any one use of Eddy currents.

Uttarakhand Board-2022

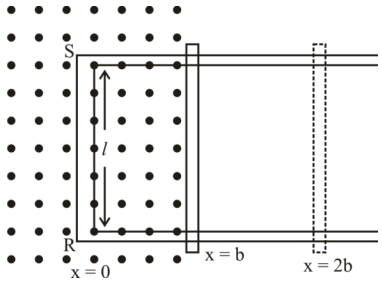
63. State Faradays law of electromagnetic induction and express it mathematically. Quantitatively show that Lenz law is consistent with the law of conservation of energy.

Nagaland Board-2020

64. State Faraday's law of electromagnetic induction. Find the mutual inductance between two long co-axial solenoids.

Jharkhand Board-2019

65. State Faraday's law of electromagnetic induction.
Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper.
The field extends from x = 0 to x = b and is zero for x > b. Assume that only the arm PQ possesses resistance r. When the arm PQ is pulled outward from x = 0 to x = 2b and is then moved backward to x = 0 with constant speed *v*, obtain the expressions for the flux and the induced emf.
Sketch the variation of these quantities with distance $0 \le x \le 2b$.



CBSE All India-2010

66. How are energy losses due to Eddy current minimized?

NIOS-2019

67. What is Electromagnetic Inductions? State Faraday's law of Electromagnetic Induction. Express second law in mathematical form. Name and state the law used for determination of direction of induced emf.

NIOS-2017

68. What are Eddy currents? Give two important properties of these currents.

NIOS-2019

69. State Faraday's law of electromagnetic induction. Illustrate the difference between self induction and mutual induction. Mention the factors affecting mutual inductance between the two coils.

UP Board-2021

70. What do you understand by electromagnetic induction? State Faraday's laws regarding electromagnetic induction.

UP Board-2023

71. The generation of emf when the magnetic flux associated with a coil changes is known as electromagnetic induction.
(a) Mention the factors on which the self inductance of a solenoid depends.
(b) Calculate the energy stored in an inductor of inductance 50mH when a current of 2A is passing through it.
(c) Two identical loops one of copper and other of aluminium are rotated with same speed in the same magnetic field. In which case the
(i) induced emf
(ii) induced current will be more and why?

Kerala Board-2013

72. A conductor of length 3m moving in a uniform magnetic field of strength 100 T. It covers a distance of 70m in 5 sec. Its plane of motion makes an angle of 30° with direction of magnetic field Calculate the emf induced in it.

Karnataka Board-March, 2019

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73. A circular coil of radius 10 cm and 25 turns is rotated about its vertical diameter with an angular speed of 40 rad S^{-1}, in a uniform horizontal magnetic field of magnitude 5×10^{-2} T. Calculate the emf induced in the coil. Also find the current in the coil if the resistance of the coil is 15Ω.

Karnataka Board-July, 2018

74. Define Self-Inductance and Mutual Inductance by explaining with example current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 200V induced, give an estimate of the self-inductance of the circuit.

Uttarakhand Board-2022

II. Magnetic Flux, Lenz's Law and Conservation of Energy

Section-A (Multiple Choice Questions)

75. Lenz's law is in accordance with the law of :

(a) Conservation of momentum
(b) Conservation of charges
(c) Conservation of energy
(d) Conservation of flux

Tamil Nadu Board-2016, 2018
Tamil Nadu Board-September, 2016
Tamil Nadu Board-March, 2016

Ans. (c) :

76. A rectangular coil of wire is placed in a uniform magnetic field such that the plane of the coil is parallel to the field. The magnetic flux linked with the coil and the emf induced are respectively.

(a) zero and zero
(b) zero and maximum
(c) maximum and zero
(d) maximum and maximum

Tamil Nadu Board-March, 2016

Ans. (b) :

77. The magnetic flux linked to a coil of 10 turns changes by 40 mWb in a time of 2 ms. The magnitude of the induced emf produced in the coil is

(a) 220 volts (b) 2000 volts
(c) 200 volts (d) 0.2 volt

Meghalaya Board-2015

Ans. (c) :

78. The force $(\vec{F})$ acting of a particle of charge q moving with velocity $(\vec{v})$ in magnetic field $(\vec{B})$ is :

(a) $\frac{q}{\vec{v}\times\vec{B}}$ (b) $\frac{\vec{v}\times\vec{B}}{q}$
(c) $q(\vec{v}\times\vec{B})$ (d) $\vec{v}\times\vec{q}\times\vec{B}$

Haryana Board-2022

Ans. (c) :

79. Lenz's law is a consequence of the law of conservation of:

(a) Charge (b) Momentum
(c) Energy (d) Mass

Haryana Board-2022

Ans. (c) :

80. Current of 2A passing through a coil of 100 turns gives rise to a magnetic flux of 5×10^{-3} Wb per turn. The magnetic energy associated with coil is ——.

(a) 5J (b) 0.5×10^{-3}J
(c) 5×10^{-3} J (d) 0.5 J

Gujarat Board- May, 2021

Ans. (d) :

81. A square of L meters lies in the xy plane in a region, where the magnetic field is given by $\vec{B} = B_0(2\hat{i}+3\hat{j}+4\hat{k})T$, where B_0 is constant. The magnitude of flux passing through the square is ____ Wb.

(a) $4B_0L^2$ (b) $3B_0L^2$
(c) $2B_0L^2$ (d) $\sqrt{29}B_0L^2$

Gujarat Board-2023
Gujarat Board- August, 2020, 2023

Ans. (a) :

82. The magnitude of the induced emf is equal to the time rate of change of .....

(a) Electric flux (b) Magnetic force
(c) Magnetic flux (d) Electric force

Gujarat Board- March, 2020

Ans. (c) :

83. The magnetic flux linked with a coil of N turns of area of cross-section A held with its plane parallel to the field B is

(a) NAB (b) NAB/2
(c) NAB/4 (d) zero

Jharkhand Board-2023

Ans. (d) :

84. Two identical circular coaxial coils A and B, arranged in vertical planes parallel to each other, carry currents in the same direction. If the distance between the coils is decreased at a constant rate, the current :

(a) increases in A and decreases in B.
(b) decreases in both A and B.
(c) increases in both A and B.
(d) remains same in both A and B.

CBSE-2023

Ans. (b) :

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85. A circular loop of radius r, carrying a current I lies in y-z plane with its centre at the origin. The net magnetic flux through the loop is:

(a) directly proportional to r
(b) zero
(c) inversely proportional to r
(d) directly proportional to I

CBSE-2020

Ans. (b) :

86. If a circular coil of 100 turns with a cross-sectional area of 1 m^2 is kept with its plane perpendicular to the magnetic field of 1 T, the magnetic flux linked with the coil will be _____.

(a) 1 Wb (b) 50 Wb
(c) 100 Wb (d) 200 Wb

Maharashtra Board-2023

Ans. (c) :

87. The SI unit of magnetic flux is

(a) coulomb (b) ampere
(c) weber (d) farad

Odisha Board-2023
Uttarakhand Board-2022
Bihar Board-2021

Ans. (c) :

Section-B (Very Short Answer)

88. Give the dimensions of Tesla.

Assam Board-2014

89. Weber is the unit of which physical quantity?!

J&K Board-2011

90. Name the physical quantity which is set up in a coil when change in magnetic flux takes place through it.

J&K Board-2011

91. State lenz's law

MP Board-2013, 2021
J&K Board-2018
Haryana Board-2017

OR

State' Lenz's law in electromagnetic induction.

Karnataka Board-July, 2018

92. Magnetic flux associated with a coil having 10 turns decreases from 0.8 Wb to 0.2 Wb in 0.1 sec. Find out induced e.m.f. across the ends of the coil.

Rajasthan Board-2011

93. Explain how Lenz's law supports the law of conservation of energy.

Bihar Board-2023
Meghalaya Board-2018
Nagaland Board-2018
Assam Board-2014

OR

State Lenz's law and explain that it is in accordance with the law of conservation of energy.

Meghalaya Board-2018, 2023
Odisha Board-2022

OR

Lenz's law of electromagnetic induction follows the principle of conservation of energy. Discuss it.

Bihar Board-2019

94. Write the S.I. unit and dimensional formula of magnetic flux.

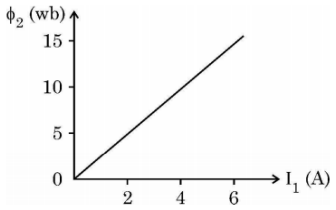
MP Board-2021
CBSE-2020
Odisha Board-2020
Chhattisgarh Board-2018

95. The magnetic flux linked with a closed loop is $\phi_B = 6t^2 + 7t + 1$, where ϕ_B in milli-weber and t in second. What will be the induced e.m.f. after t = 2 seconds?

96. The instantaneous magnetic flux linked with a coil at time t is given by $\phi = (4t^3 - 5t^2 - 10t + 70)$ weber. Calculate the emf induced in the coil at time t = 2 second.

UP Board-2018

97. Two coils C_1 and C_2 are placed close to each other. The magnetic flux ϕ_2 linked with the coil C_2 varies with the current I_1 flowing in coil C_1, as shown in the figure. Find



(i) the mutual inductance of the arrangement, and

(ii) the rate of change of current $\left(\frac{dI_1}{dt}\right)$ that will induce an emf of 100 V in coil C_2.

CBSE-2023

98. Consider an induced magnetic field due to changing electric field and an induced electric field due to changing magnetic field. Which one is more easily observed ? Justify your answer.

CBSE-2023

99. Explain Lenz's Law considering a closed conducting coil and a bar magnet.

Assam Board-2017

100. When bulk pieces of conductors are subjected to changing magnetic flux, currents are induced in them.

(a) Write the name of this induced current.
(b) Write any two practical applications of this current.

Kerala Board-2021

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101. What does the negative sign indicate in Lenz's law?

Maharashtra Board-2020

102. Define Magnetic Flux. What are Positive and Negative Flux?

J&K Board-2011

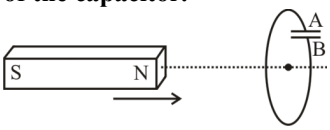
103. On what factors, does the magnitude of the emf induced in the circuit due to magnetic flux depend?

CBSE Foreign-2013

104. State Lenz's law. A metallic rod held horizontally along east-west direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer.

CBSE Delhi-2013

105. In the given figure, a bar magnet is quickly moved towards a conducting loop having a capacitor. Predict the polarity o the plates A and B of the capacitor.



CBSE All India-2014, 2010

106. What is the significance of Lenz's law?

Karnataka Board-March, 2015, 2017, 2020

Karnataka Board-July, 2016

107. On what factors the magnetic flux associated a coil depends?

Uttarakhand Board-2020

108. What is Lorentz force? Write expression for it.

Uttarakhand Board-2022

Section-C (Short Answer)

109. In a region, an electric field $\vec{E} = 5 \times 10^3 j\ NC^{-1}$ and a magnetic field of $\vec{B} = 0.1kT$ are applied. A beam of charged particles are projected along X-direction. Find the velocity of charged particles which move undeflected in this crossed fields.

Karnataka Board-March, 2020

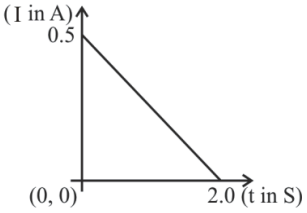
110. When a conducting loop of resistance 10Ω and area 10 cm^2 is removed from an external magnetic field acting normally, the variation of induced current-I in the loop with time t is as shown in the figure.

Find the

(a) total charge passed through the loop

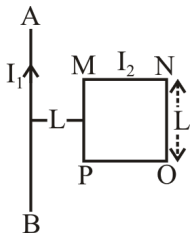
(b) change in magnetic flux through the loop

(c) magnitude of the field applied.



CBSE-2020

111. A square shaped current carrying loop MNOP is placed near a straight long current carrying wire AB as shown in the fig. The wire and the loop lie in the same plane. If the loop experiences a net force F towards the wire, find the magnitude of the force on the side 'NO' of the loop.



CBSE-2020

112. What is magnetic flux ? Write its SI unit. Explain its relation with magnetic field lines using a diagram.

Haryana Board-2018

113. State Faraday's laws and Lenz's law of electromagnetic induction.

Tamil Nadu Board-2011

114. Write Lenz's law regarding electromagnetic induction and explain how Lenz's law is equivalent to the law of conservation of energy.

MP Board-2019

115. What is meant by the term 'mutual inductance' of a pair of coils ? Obtain an expression for the mutual inductance of two long coaxial solenoids, each of length *l* but having different number of turns N_1 and N_2 and radii r_1 and r_2 ($r_2 > r_1$).

CBSE-2023

116. State and explain Lenze's law.

Meghalaya Board-2013

117. State Lenz's law of electromagnetic induction and mention its significance.

Odisha Board-2020

118. Write Lenz's law of electromagnetic induction. Show that Lenz's law follows the energy conservation law. 3

Uttarakhand Board-2019

Section-D (Case-Based Questions)

119. A teacher was teaching the law of Lenz in his Physics class. He told the children that Lenz's law tells us the direction of induced current in the circuit. According to this rule, the direction of the induced electric carrying force (electromotive force) is always (for the reasons) opposed to the change in the magnetic flux that caused it. This means that if the electric carrying force (electromotive force) is induced by the increase in the magnetic flux, the direction of electromotive force will always oppose the increase in magnetic flux and the opposite will always be true.

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Answer the following question:

(i) Does the law of Lenz not follow the law of conservation of energy?

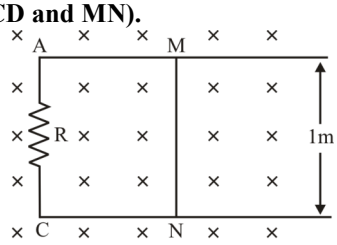
(ii) By which other law one can find the direction of induced current?

(iii) How is the law of Lenz useful in daily life?

Chhattisgarh Board-2021

Section-E (Long Answer)

120. (i) AB and CD are two parallel conductors kept 1m apart and connected by a resistance R of 6 Ω, as shown in figure below. They are placed in a magnetic field $B = 3 \times 10^{-2}$ T which is perpendicular to the plane of the conductors and directed into the paper. A wire MN is placed over AB and CD and then made to slide with a velocity 2 ms^{-1}. (Neglect the resistance of AB, CD and MN).



Calculate the induced current flowing through the resistor R.

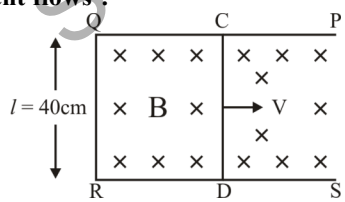
(ii) In an ideal transformer, an output of 66 kV is required when an input voltage of 220 V is available. If the primary has 300 turns, how many turns should the secondary have ?

ISC-2017

121. A metallic rod CD rests on a thick metallic wire PQRS with arms PQ and RS parallel to each other, at a distance l = 40cm, as shown in figure. A uniform magnetic field B = 0.1T acts perpendicular to the plane of this paper, pointing inwards (i.e., away from the reader). The rod is now made to slide towards right with a constant velocity of v = 5.0ms^{-1}

(i) How much emf is induced between the two ends of the rod CD ?

(ii) What is the direction in which the induced current flows ?

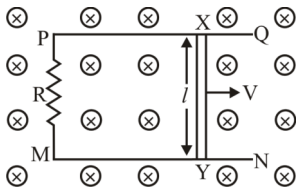


ISC-2013

122. State and explain Lenz's law. How will you verify it experimentally?

J&K Board-2017

123. PQ and MN are two parallel conductors at a distance l apart and connected by a resistance R as shown in figure. They are placed in a magnetic field B which is perpendicular to the plane of the conductors. A wire XY is placed over PQ and MN and then made to slide over PQ and MN with a velocity v. Neglecting the resistance of PQ, MN and wire XY, calculate the work done per second to slide the wire XY.



ISC-2006

124. A rectangular coil rotates in a uniform magnetic field. Obtain an expression for induced emf and current at any instant. Also find their peak values. Show the variation of induced emf versus angle of rotation (ωt) on a graph.

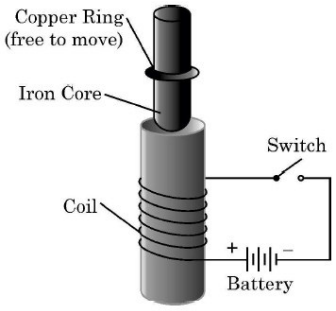
(b) An iron bar falling through the hollow region of a thick cylindrical shell made of copper experiences a retarding force. What can you conclude about the nature of the iron bar? Explain.

CBSE-2019

125. A wheel with 100 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. If the resultant magnetic field at that place is 4×10^{-4} T and the angle of dip at the place is 30°, find the emf induced between the axle and the rim of the wheel.

CBSE-2019

126. (a) Consider the experimental set up shown in the figure. This jumping ring experiment is an outstanding demonstration of some simple laws of Physics. A conducting non-magnetic ring is placed over the vertical core of a solenoid. When current is passed through the solenoid, the ring is thrown off.



Answer the following questions :

(i) Explain the reason of jumping of the ring when the switch is closed in the circuit.

(ii) What will happen if the terminals of the battery are reversed and the switch is closed ? Explain

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(iii) Explain the two laws that help us understand this phenomenon.

CBSE-2023

127. State Lenz's law. Show that Lenz's law is a direct consequence of law of conservation of energy.

Bihar Board-2022
Meghalaya Board-2014

III. Motional Electromotive Force

Section-A (Multiple Choice Questions)

128. Direction of current induced in a wire moving in a magnetic field is found using
(a) Fleming's left hand rule
(b) Fleming's right hand rule
(c) Ampere's rule
(d) None of these

Jharkhand Board-2023

Ans. (b) :

129. A square shaped coil of side 10 cm, having 100 turns is placed perpendicular to a magnetic field which is increasing at 1 T/s. The induced emf in the coil is
(a) 0.1 V (b) 0.5 V
(c) 0.75 V (d) 1.0 V

CBSE-2023

Ans. (d) :

130. A circular coil of radius 8.0 cm and 40 turns is rotated about its vertical diameter with an angular speed of $\frac{25}{\pi}$ rad s^{-1} in a uniform horizontal magnetic field of magnitude 3.0×10^{-2} T. The maximum emf induced in the coil is :
(a) 0·12 V (b) 0·15 V
(c) 0·19 V (d) 0.22 V

CBSE-2023

Ans. (c) :

131. Middle finger of Fleming's right hand rule represents
(a) direction of motion
(b) direction of magnetic field
(c) direction of induced current
(d) none of these

Bihar Board-2021

Ans. (c) :

Section-B (Very Short Answer)

132. Under what condition, is terminal voltage of a cell equal to its Electromotive force?

Haryana Board-2022

133. What are the methods of producing induced emf?

J&K Board-2023
Rajasthan Board-2011, 2017
Tamil Nadu Board-March, 2016

134. State Fleming's right hand rule.

Tamil Nadu Board-2011, 2017, 2022

135. An AC generator consists of a coil of 10,000 turns and of area $100cm^2$. The coil rotates at an angular speed of 140 rpm in a uniform magnetic field of 3.6×10^{-2} T. Find the maximum value of the emf induced

Tamil Nadu Board-2017

136. What is the basic cause of induced e.m.f.?

J&K Board-2023

137. A conducting rod moves with a certain velocity in a uniform magnetic field. Derive an expression for the induced electromotive force between the ends of the rod.

Jharkhand Board-2023

138. What causes the core of a transformer to get heated up under operation ?

ISC-2004

139. The SI unit of coefficient of inductance is henry. Using any defining equation for L or M show that 1H = 1Ω–s.

ISC-2007, 2003

140. A rectangular coil of area $50cm^2$ and 100 turns is placed perpendicular to a magnetic field of 10^{-2} Wb/m^2. If the coil is withdrawn from the field in 40 ms, calculate the emf induced.

ISC-2005

141. A conducting rod of length *l* is kept parallel to a uniform magnetic field $\vec{B}$. It is moved along the magnetic field with a velocity $\vec{v}$. What is the value of emf induced in the conductor?

CBSE-2020

142. Induced e.m.f is sometimes known as back e.m.f why ?

Meghalaya Board-2021

143. A long straight current carrying wire passes normally through the centre of circular lop. if the current through the wire increases, will there be an induced emf in the loop? Justify.

CBSE Delhi-2017

144. A coil with 500 turns and area of $100cm^2$ is placed perpendicular to magnetic field. In 0.1 second the magnetic field decreases from 0.2 weber $/m^2$ to zero. Calculate the induced electromotive force in the coil.

Uttarakhand Board-2023

145. Obtain an expression for the emf induced across a conductor which is moved in a uniform magnetic field which is perpendicular to the plane of motion.

AP Board-2022

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Section-C (Short Answer)

146. If a metal rod of length *l* is placed normal to a uniform magnetic field (B) and moved with a velocity (v) perpendicular to the magnetic field, then find the induced emf (motional emf) between its ends. Draw the necessary diagram.

Rajasthan Board-2022

147. Explain motional emf and derive ε = B/v.

Gujarat Board- July, 2022

148. When the current flowing through a coil P decreases from 5A to 0 in 0.2 s, an emf of 60V is induced across terminals of an adjacent coil Q. Calculate the coefficient of mutual inductance of the two coils P and Q.

ISC-2009

149 The current in an inductance of 5 Henry becomes 7 ampere from 12 ampere in 0.1 second. How much induced electromotive force will be induced ?

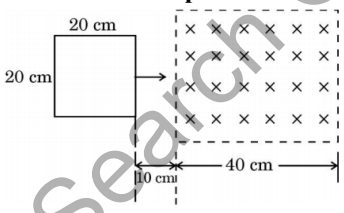
UP Board-2018

150. With the help of a neatly drawn labelled diagram, prove that the magnitude of motional emf e is given by e = B*l*v, where *l* is the length of a metallic rod and v is the velocity with which it is pulled in a transverse magnetic field B.

ISC-2010, 2003

151. (a) Two coplanar concentric circular loops of radii R and r (<< R) are arranged coaxially. Obtain the expression for their mutual inductance.

(b) A square loop of side 20 cm starts moving at t = 0 with a velocity of 5 cm/s towards a region of uniform magnetic field as shown in the figure. Specify the time interval(s) during which induced emf is produced in the loop.



CBSE-2023

152. A long solenoid of radius r consists of n turns per unit length. A current $I = I_0 \sin \omega t$ flows in the solenoid. A coil of N turns is wound tightly around it near its centre. What is :

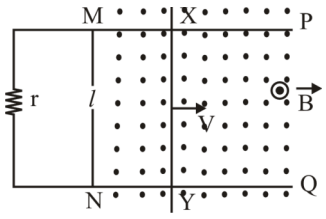
(a) the induced emf in the coil ?

(b) the mutual inductance between the solenoid and the coil ?

CBSE-2023

153. A conducting rod XY of length *l* slides on two smooth parallel rails PM and QN with a uniform velocity v. The resistances of the rod and the rails are negligible.

A uniform magnetic field $\vec{B}$ perpendicular to the plane PMNQ is present in the region pointing vertically upwards as shown in the figure. A small resistance r is connected between the ends M and N of the rails. Obtain

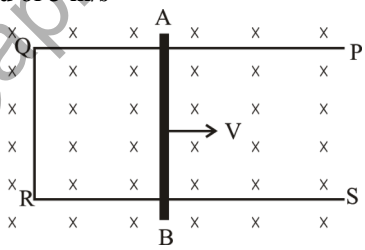


(i) the expression for emf induced across the ends of the rod and its polarity.

(ii) the magnitude and direction of induced current that flows through resistance r.

CBSE-2020

154. A metal rod AB of length 20 cm is kept in contact with a conductor PQRS of negligible resistance to form a loop as shown in the figure. A magnetic field of 0.2 T is acting perpendicular to the plane of the loop. The resistance of the rod AB is 2Ω . Determine the force required to move the rod at a constant speed of 3 m/s

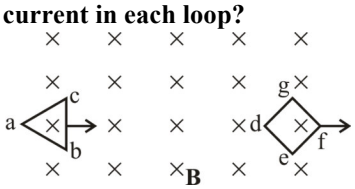


Goa Board-2018

155. State the principle of an AC generator and explain its working with the help of a labelled diagram. Obtain the expression for the emf induced in a coil having N turns each of cross-sectional area A, rotating with a constant angular speed ω in a magnetic field (B), directed perpendicular to the axis of rotation.

CBSE-2019

156. Two loops of difference shapes are moved into a region of uniform magnetic field in the directions marked by arrows as shown in the figure. What is the direction of the induced current in each loop?



CBSE Foreign-2010

157. Give the principle of cyclotron and draw the neat labelled schematic diagram of cyclotron.

Karnataka Board-March, 2020

Ans. () :

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158. Derive an expression for electromotive force (motional emf) induced in a rod moving perpendicular to the uniform magnetic field.

Karnataka Board-July, 2014, 2016
Karnataka Board-March, 2015

Section-D (Case-Based Questions)

159. Ajay and his friends went for a walk. There they saw a metallic chain attached to a truck touching the ground. It was also written on the truck, "beware highly inflammable". Ajay explained to his friends that during motion of truck, magnetic lines of the earth are cut by its axle and due to this some e.m.f. will be induced across its ends. This induced charge is discharging to the earth through this metallic chain and explosive materials are safe.

Answer the following questions on the basis of the above paragraph : 1+2+1=4]

(i) When does an induced e.m.f. produce?

(ii) Name and state the law which gives direction of induced current.

(iii) Write the values displayed by Ajay (any two).

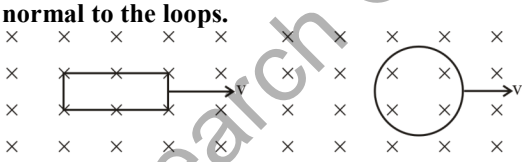
Chhattisgarh Board-2020

Section-E (Long Answer)

160. Deduce expression for electromotive force induced across the ends of the a conducting rod moving in an uniform magnetic field.

MP Board-2019

161. A rectangular loop and a circular loop are moving out of a uniform magnetic field (field - free) region with a constant velocity v as shown in the figure. In which loop, do you expect the induced emf to be constant during the passage out of the field region? The magnetic field is normal to the loops.



CBSE All India-2011

162. Consider the motion of a charged particle of mass m and charge q moving with velocity v in a magnetic field B.

(i) If v is perpendicular to B, then show that it describes a circular path having angular frequency $\omega = qB/m$.

(ii) If the velocity v has a component parallel to the magnetic field B, then trace the path described by the particle. Justify your answer.

CBSE All India-2014

163. (i) A rod of length *l* is moved horizontally with a uniform velocity *v* in a direction perpendicular to its length through a region in which a uniform magnetic field is acting vertically downward. Derive the expression for the emf induced across the ends of the rod.

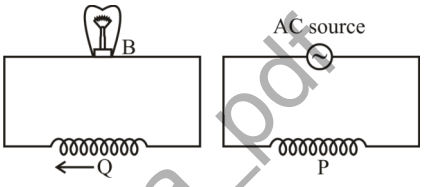
(ii) How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain.

CBSE All India-2014

164. A coil Q is connected to low voltage bulb B and placed near another coil P as shown in the figure. Given reasons to explain the following observations.

(i) The bulb B lights

(ii) Bulb gets dimmer, if the coil Q is moved towards left



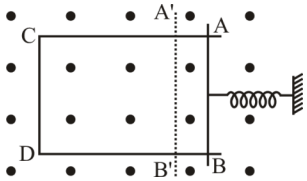
CBSE Delhi-2010

165. A metallic rod of length L is rotated with angular frequency of ω with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field. B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring.

CBSE Delhi-2012

166. A rectangular frame of wire is placed in a uniform magnetic field directed outwards, normal to the paper. AB is connected t a spring which is stretched to A' B' and then released at time t = 0. Explain qualitatively how induced electro motive force in the coil would vary with time.

(Neglect damping of oscillations of spring)



CBSE-2018

167. An aeroplane is flying horizontally from west to east with a velocity of 900 km/h.

Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of the earth's magnetic field is 5×10^{-4} T and the angle of dip is 30°.

CBSE-2018

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IV. Inductance (Mutual and Self Inductance)

Section-A (Multiple Choice Questions)

168. The SI unit of self-inductance is
(a) joule (b) fared
(c) ampere (d) henry
Odisha Board-2022

Ans. (d) :

169. An emf of 12 V is induced when the current in the coil changes at the rate of 40 A s^{-1}. The coefficient of self induction of the coil is :
(a) 0.3 H (b) 0.003 H
(c) 30 H (d) 4.8 H
Tamil Nadu Board-2016

Ans. (a) :

170. The unit henry can also be written as
(a) VsA^{-1} (b) WbA^{-1}
(c) Ω s (d) all of these
Tamil Nadu Board-2011, 2015

Ans. (d) :

171. In a circular coil if number of turns is doubled and resistance becomes $\frac{1}{4}$th of the initial value, then inductance becomes
(a) 4 times (b) 2 times
(c) 8 times (d) no change
Nagaland Board-2018

Ans. (a) :

172. For a coil having self-inductance 3 mH current flows at a rate of 10^3 ampere/sec in it. The emf induced in it is:
(a) 1 Volt (b) 2 Volt
(c) 3 Volt (d) 4 Volt
Haryana Board-2022

Ans. (c) :

173. Dimensional formula of mutual inductance is – –.
(a) $M^1L^2T^{-2}A^{-1}$ (b) $M^1L^2T^{-2}A^{-2}$
(c) $M^1L^{-2}T^2A^2$ (d) $M^{-1}L^{-2}T^2A^{-1}$
Gujarat Board- March, 2020

Ans. (b) :

174. A small square loop of wire of side 1 mm is placed inside a large square loop of wire of side 10m. The loops are coplanar and their centres coincide. Find the mutual inductance of the system. $(\mu_0 = 4\pi \times 10^{-7}$ S.I.$)$
(a) $2\sqrt{2} \times 10^{-14}$ H (b) $4\sqrt{2} \times 10^{-14}$ H
(c) $8\sqrt{2} \times 10^{-14}$ H (d) $6\sqrt{2} \times 10^{-14}$ H
Gujarat Board- March, 2019

Ans. (c) :

175. Two concentric rings are kept in the same plane. Number of turns in both the rings is 20. Their radii are 40 cm and 80 cm and they carry electric currents of 0.4A and 0.6A respectively, in mutually opposite directions. The magnitude of the magnetic field produced at their centre is__T.
(a) $2\mu_0$ (b) $4\mu_0$
(c) $\frac{10}{4}\mu_0$ (d) $\frac{5}{4}\mu_0$
Gujarat Board- March, 2019

Ans. (c) :

176. Which of the following is not a unit of magnetic induction?
(a) Weber/meter^2
(b) Gauses
(c) Tesla
(d) Newton-meter/Ampere
Gujarat Board-2023

Ans. (d) :

177. Current in a circuit falls from 5 A to 0 A in 0.1 s. If an average emf of 200 V induced. the self-inductance of the circuit would be _____H.
(a) 3 (b) 2
(c) 1 (d) 4
Gujarat Board-March, 2022

Ans. (d) :

178. If number of turns in primary and secondary coils is increased to two times each, the mutual inductance
(a) becomes 4 times
(b) becomes 2 times
(c) becomes $\frac{1}{4}$ time
(d) remains unchanged
Jharkhand Board-2023

Ans. (a) :

179. The self inductance of coil does not depend on :
(a) the length of coil
(b) the current on the coil
(c) the radius of coil
(d) the number of turns of coil
MP Board-2022

Ans. (b) :

180. S.I. unit of self-inductance of a solenoid is :
(a) Volt/second (b) Ohm-second
(c) Volt-second (d) Ohm/second
MP Board-2019
NIOS-2019

Ans. (d) :

181. Coefficient of mutual inductance of two coils is 1 H. Current in one of the coils is increased from 4 to 5 A in 1 ms. What average emf will be induced in the other coil?

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(a) 1000 V (b) 2000 V
(c) 100 V (d) 200 V

Kerala Board-2020

Ans. (a) :

182. When current changes from +2A to – 2A in 0.05 s, an e.m.f. of 8 V is induced in a coil. The coefficient of self-induction of the coil is

(a) 0.8 H (b) 0.4 H
(c) 0.1 H (d) 0.2 H

Meghalaya Board-2019

Ans. (c) :

183. In a coil having coefficient of self-induction 5 H, the rate of change of current is 2 As^{-1}. Then e.m.f. induced in the coil is

(a) 10V (b) –10V
(c) 5V (d) –5V

Meghalaya Board-2017

Ans. (b) :

184. The self-inductance of a choke coil is 5 henry. The current through it is increasing at a rate of 2 AS^{-1}. The self-induced emf in the choke coil will be

(a) 2.5 V (b) 5 V
(c) –10 V (d) 10 V

Bihar Board-2023

Ans. (d) :

185. When current in a coil changes from 5A to 2A in 0.1s then average voltage of 50V is produced. The self - inductance of the coil is

(a) 1.67 henry (b) 6 henry
(c) 3 henry (d) 0.67 henry

Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

186. Define 1 henry of self-inductance.

UP Board-2023

187. What is self-induction? Give its S.I unit.

J&K Board-2023

188. What is self-induction?

J&K Board-2023
Haryana Board-2016
Meghalaya Board-2015
Karnataka Board-July, 2015

189. To reduce current in an circuit. An inductor coil is preferred to a resistor . Why?

Goa Board-2018

190. An emf of 2V is induced in a coil, when current in it is changed from 0A to 10A in 0.40s. Find the coefficient of self-inductance of the coil.

ISC-2011

191. A coil has a self-inductance of 0.05 H. Find magnitude of the emf induced in it when the current flowing through it is changing at the rate 100 As^{-1}.

ISC-2016

192. What is S.I. unit of mutual inductance?

J&K Board-2011

193. The number of turns of a solenoid are doubled without changing its length and area of cross - section. the self-section. The self-inductance of the solenoid will become ___ times.

CBSE-2020

194. Obtain an expression for the coefficient of mutual induction between two long solenoids.

Tamil Nadu Board-September, 2016

195. Explain how an emf can be induced by changing the area enclosed by the coil.

Tamil Nadu Board-2015

196. Calculate the mutual inductance between two coils when a current of 4A changing to 8 A in 0.5 s in one coil, induces an emf of 50 mV in the other coil.

Tamil Nadu Board-2015

197. Current in a circuit falls from 5.0A to 1.0A in 0.1s . If an average e.m.f. of 200V induced. Give an estimate of the self inductance of the circuit.

Rajasthan Board-2023

198. Derive $W = \frac{1}{2}LI^2$ as the energy required to build up the current I in the coil having self-inductance L.

Gujarat Board- July, 2022
Assam Board-2015
CBSE Delhi-2010

199. Define coefficient of self induction and coefficient of mutual induction.

MP Board-2021
Jharkhand Board-2020

200. What is the effect on self inductance of a solenoid, if a core of soft iron is placed in it?

MP Board-2015

201. The self inductance of two coils P and S are L_1 and L_2. The coupling between them is ideal. Show that the mutual inductance between these coils is $M = \sqrt{L_1L_2}$

MP Board-2015

202. Write difference between self induction and Mutual induction.

MP Board-2021, 2022

203. What is mutual induction?

Chhattisgarh Board-2018

204. (a) Define the SI unit of self-inductance.
(b) The self-inductance of a solenoid is L. If the number of turns per unit length in it is doubled and the area of cross-section is halved, find the new inductance of the solenoid.

CBSE-2020

205. Write the dimensions of self-inductance of a coil.

CBSE-2020

Search On TG: @apna_pdf

206. Current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 200 V is induced, calculate the self-inductance of the circuit.

Kerala Board-2021
Karnataka Board-2015
CBSE Foreign-2011

207. Derive an expression for the coefficient of mutual induction of two long solenoids.

Meghalaya Board-2017

208. A solenoid 3.142m long and 5.0 cm in diameter has two layers of windings of 500 turns each and carries a current of 5A. Calculate the magnetic induction at its centre along the axis.

Maharashtra Board-2015

209. A light metal disc on the top of an electromagnet is thrown u as the current is switched on. Why? Give reason.

CBSE All India-2013

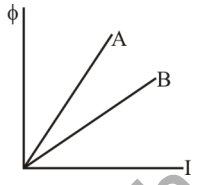
210. How does the mutual inductance of a pair of coils change, when
(i) Distance between the coils is increased and
(ii) number of turns in the coils is increased?

CBSE All India-2013

211. How can the self-Inductance of a given coil having N number of turns, area of cross-section A and length *l* be increased?

CBSE Delhi-2012

212. A plot of magnetic flux (ϕ) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value f self-inductance?



CBSE Delhi-2010

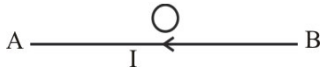
213. Define the term self-inductance of a coil. Write its SI unit.

CBSE Delhi-2015
CBSE All India-2010

216. Define mutual inductance and writes its SI unit.

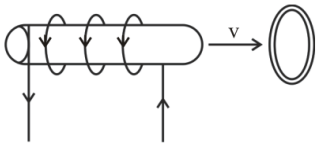
CBSE Delhi-2019

214. The electric current flowing in a wire in the direction from B to A is decreasing. Find out the direction of the induced current in the metallic loop kept near the wire as shown in the figure.



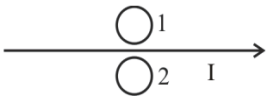
CBSE All India-2014

215. Figure shows a current carrying solenoid moving towards conducting loop. Find the direction of the current induced in the loop.



CBSE Delhi-2015

216. What is the direction of induced currents in metal rings 1 and 2, when current I in the wire is increasing steadily?



CBSE All India-2017

217. The self-inductance of a coil is inversely proportional to the number of turns in it. (Correct the sentence by changing the underlined word, if necessary)

Odisha Board-2020

221. How the self inductance of a coil depends on number of turns in the coil?

Karnataka Board-March, 2019

218. What is a toroid? Mention an expression for magnetic field at a point inside a toroid.

Karnataka Board-March, 2016

219. The current in a coil of self inductance 5 mH changes from 2.5 A to 2.0 A in 0.01 second. Calculate the value of self induced emf.

Karnataka Board-March, 2016

220. Mention any two factors on which the self inductance of a coil depends.

Karnataka Board-July, 2018

221. What is meant by self induction and Mutual inductance?

Karnataka Board-July, 2016

222. Current through a coil of 2mH changes from zero ampere to 5 mA in 0.1 second. What is the emf induced in the coil?

Karnataka Board-July, 2020

223. What do you understand by mutual induction? On what factors the mutual inductance between two coils depend?

Uttarakhand Board-2020

Section-C (Short Answer)

224. Derive an expression for the self-inductance of a long solenoid carrying current.

Uttarakhand Board-2019, 2023
Jharkhand Board-2018
Tamil Nadu Board-2016, 2017
MP Board-2015
Rajasthan Board-2011

OR

What is called self-inductance? Derive an expression for self- induced emf.

MP Board-2023
Gujarat Board- March, 2020

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225. **Define mutual inductance and mention the factors on which mutual inductance depends.**

Gujarat Board-2023

226. **Explain in brief the phenomenon of self-induction. Derive the formula for self-induced emf.**

Gujarat Board-March, 2022

227. **Derive an expression for self-inductance of a long solenoid of length *l*, cross-sectional area A having number of turns N.**

Nagaland Board-2018

228. **What is mutual inductance? Explain.**

Haryana Board-2018

229. **Obtain an expression for the mutual inductance of two long solenoids.**

AP Board-2020
Tamil Nadu Board-2018

230. **A circular coil of 200 turns and radius 20cm carries a current of 5A. Calculate the magnetic induction at a point along its axis, at a distance three times the radius of the coil from its centre.**

Tamil Nadu Board-2018

231. **Explain the phenomenon of self-induction. Define coefficient of self -induction.**

J&K Board-2017

232. **Define Mutual Inductance. Write its S.I. unit. Give two factors on which the Mutual Inductance of a pair of coils depends.**

J&K Board-2012

233. **Derive an expression of the mutual conductance for a pair of long co-axial solenoids.**

Nagaland Board-2017

234. **What is self induction? Deduce an expression for energy required to build up a circuit.**

Nagaland Board-2021

235. **A circular coil of radius 8 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude 3×10^{-2}T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10 Ω, calculate the maximum value of current in the coil.**

Gujarat Board-March, 2022

236. **Derive expression for the self-inductance of a long solenoid. What factors affect its value?**

MP Board-2018

237. **What do you mean by self induction coefficient or self inductance ? Write its unit and dimensional formula and on what factors does it depend ?**

Chhattisgarh Board-2023

238. **A current of 2.5 amperes in a 1000 turns coil produces 0.5×10^{-5} weber magnetized flux in each turn. Find out the self-inductance of coil.**

Chhattisgarh Board-2021

239. **A current of 4 A flows in a coil when connected to a 12V DC source. If the same coil is connected to a 12V, 8 Hz AC source, a current 2.4 A flows in the coil. Calculate the coefficient of self-inductance L of the coil.**

ISC-2005

240. **Define self-inductance. Obtain the expression for the self-inductance of a solenoid, explaining steps with the help of a diagram.**

ISC-2000

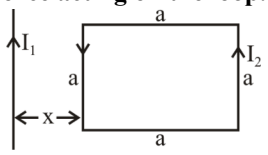
241. **What is coefficient of self-inductance? An iron-cored solenoid has self-inductance of 2.8 H. When the core is removed, the self-inductance becomes 2 mH. What is the relative permeability of the core used?**

Chhattisgarh Board-2019

242. **(a) How are eddy currents generated in a conductor which is subjected to a magnetic field?**
(b) Write two examples of their useful applications.
(c) How can disadvantages of eddy currents be minimized ?

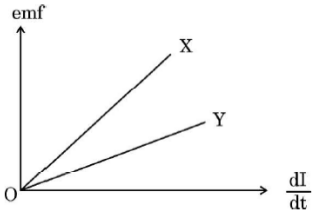
CBSE-2019

243. **(a) Define mutual inductance and writes its S.I. unit**
(b) A square loop of side 'a' carrying a current I_2 is kept at distance x from an infinitely long straight wire carrying a current I_1 as shown in the figure. Obtain the expression for the resultant force acting on the loop.



CBSE-2019

244. **(a) The figure shows the variation of induced emf as a function of rate of change of current for two identical solenoids X and Y. One is air cored and the other is iron cored. Which one of them is iron cored ? Why ?**



CBSE-2023

245. **(b) Obtain an expression for self-inductance of a long solenoid of length L and cross-sectional area A having N turns.**

CBSE-2023

246. **(a) (i) Define coefficient of self-induction. Obtain an expression for self-inductance of a long solenoid of length *l*, area of cross-section A having N turns.**

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(ii) Calculate the self-inductance of a coil using the following data obtained when an AC source of frequency $\left(\frac{200}{\pi}\right)$ Hz and a DC source is applied across the coil.

AC Source		
S.No.	V (Volts)	I (A)
1	3.0	0.5
2	6.0	1.0
3	9.0	1.5

DC Source		
S.No.	V (Volts)	I (A)
1	4.0	1.0
2	6.0	1.5
3	8.0	2.0

CBSE-2023

247. (a) Differentiate between self inductance and mutual inductance.

(b) The mutual inductance of two coaxial coils is 2H. The current in one coil is changed uniformly from zero to 0.5A in 100 ms. Find the :

(i) change in magnetic flux through the other coil.

(ii) emf induced in the other coil during the change.

CBSE-2020

248. Two coplanar and concentric circular loops are of radii 0.5 cm and 11 cm, respectively. These loops are placed in a uniform external magnetic field of 0.4 T acting perpendicular to their plane. Calculate the mutual inductance of the arrangement.

CBSE-2020

249. Describe any one experiment where generation of induced emf can be clearly demonstrated.

Assam Board-2023

250. Find the expression for mutual inductance between a pair of co-axial coils.

Assam Board-2015

251. Derive an expression for coefficient of mutual induction for two long solenoids.

Meghalaya Board-2019

252. When the current through a coil changes at the rate of 1 A/s, it induces a voltage of 1 mV. What is the coefficient of self-induction of the coil?

Meghalaya Board-2013

253. When a direct current of 5 A is passed through a coil of 1000 turns, the magnetic flux produced is 1.4×10^{-4} Wb. What is the inductance of the coil?

Meghalaya Board-2014

254. An emf of 91 mV is induced in the windings of a coil, when the current in a nearby coil is increasing at the rate of 1.3 A/s, what is the mutual inductance (M) of the two coils in mH?

Maharashtra Board-2022

255. Starting from the expression for the energy $W = \frac{1}{2}LI^2$, stored in a solenoid of self-inductance L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length *l* of the solenoid having n number of turns per unit length. Hence, show that the energy density is given by $B^2/2\mu_0$.

CBSE Delhi-2013

256. The current flowing in the two coils of self-inductance L_1 = 16 mH and L_2 = 12 mH are increasing at the same rate. if the power supplied to the two coils are equal, then find the ratio of

(i) Induced voltages

(ii) The currents and

(iii) The energies stored in the coil at a given instant.

CBSE Foreign-2014

257. Define the term self-inductance of a solenoid. Obtain the expression for the magnetic energy stored in an inductor of self-inductance L to build up a current I through it.

CBSE All India-2014

258. (i) Define self-inductance. Write its SI unit.

(ii) A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 to 4.0 in 0.1s, then what is the induced emf in the loop while the current is changing?

CBSE Foreign-2015

259. (i) Define mutual inductance.

(ii) A pair of adjacent coils has mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

CBSE Delhi-2016

260. Define mutual inductance between a pair o coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.

CBSE All India-2017

261. (i) Define the term 'self-inductance' and write its SI unit.

(ii) Obtain the expression for the mutual inductance of two long co-axial solenoids S_1 and S_2 would one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 number of turns per unit length, when a current I is set up in the outer solenoid S_2.

CBSE Delhi-2017

262. Two concentric circular coils C_1 and C_2, radius r_1 and r_2 ($r_1 << r_2$) respectively are kept coaxially. If current is passed through C_2, then find an expression or mutual for mutual inductance between the two coils.

CBSE All India-2011

CBSE Foreign-2011

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263. Two concentric circular coils, one of small radius r and the other of large radius R, such that R >> r, are placed coaxially with centres coinciding. Obtain the mutual inductance of the arrangement.

CBSE All India-2011, 2010

264. Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length *l* having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.

CBSE Delhi-2012

265. Derive the expression for the magnetic energy stored in an inductor, when a current I develops in it. Hence, obtain the expression for the magnetic energy density.

CBSE All India-2019

266. Two identical loops, one of copper and the other of aluminium are rotated with the same angular speed in the same magnetic field. Compare
(i) The induced emf and
(ii) The current produced in the two coils. Justify your answer.

CBSE All India-2010

267. What is self-induction? Find an expression for the self inductance of a circular coil of N furns.

Odisha Board-2023

268. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil change from 0 to 20A in 0.5s, what is the change of flux linkage with the other coil?

Manipur Board-2022

Section-D (Long Answer)

269. What is meant by mutual induction ? Define coefficient of mutual inductance. Establish the formula for the mutual inductance of tow plane coils.

UP Board-2019

270. (i) A coil having self-inductance of 0.7 H and resistance of 165 Ω is connected to an AC source of 275 V, 50 Hz. If $\pi = \frac{22}{7}$ then calculate
(a) reactance of the coil
(b) impedance of the coil
(c) current flowing through the coil
(ii) Draw a labelled graph showing variation of impedance of a series L-C-R circuit with frequency of the AC supply.

ISC-2016

271. What do you understand by self-induction? Derive an expression for coefficient of self-inductance of solenoid.

J&K Board-2018

272. State and explain the phenomena of self-induction. Hence define the Coeff. of Self induction

J&K Board-2014, 2015

273. (a) Define self-induction and the coefficient of self-inductance.
(b) Calculate the emf (electromotive force) induced in a coil of self-inductance 10^{-2} H, when current in it changes at the rate of 20A per second.

Haryana Board-2017

274. (a) Define self and mutual inductance.
(b) Calculate self-inductance of a coil when current in it changes by 2A in 10^{-2} seconds and emf produced in 20 volts.

Haryana Board-2017

275. (a) Define mutual and self-inductance.
(b) Calculate the self-inductance of a coil when 10 V induced *emf* is produced in it due to change in current at the rate of 80 A/s.

Haryana Board-2017

276. Derive expression for the self-induction of solenoid. What factors affects its value and how?

MP Board-2013

277. (a) A metallic rod of length '*l*' and resistance 'R' is rotated with a frequency 'v' with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius '*l*', about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field 'B' parallel to the axis is present everywhere.
(i) Derive the expression for the induced emf and the current in the rod.
(ii) Due to the presence of current in the rod and of the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.
(iii) Hence, obtain an expression for the power required to rotate the rod.
(b) A copper coil is taken out of a magnetic field with a fixed velocity. Will it be easy to remove it from the same field if its ohmic resistance is increased?

CBSE-2019

278. Derive the expression for the magnetic energy stored in an inductor when a current I develops in it. Hence, obtain the expression for the magnetic energy density.

CBSE-2019

279. Find the wavelength of the electron orbiting in the first excited state in hydrogen atom.

CBSE All India-2016

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280. **(i) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.**

(ii) The current flowing through an inductor of self-inductance L is continuously increasing. Plot a graph showing the variation of

(A) Magnetic flux versus the current.

(B) induced emf versus dI/dt.

(C) Magnetic potential energy stored versus the current.

CBSE Delhi-2014

281. **(i) Define mutual inductance and write its SI units.**

(ii) Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.

(iii) In an experiment, two coils C_1 and C_2 are placed close to each other. Find out the expression for the emf induced in the coil C_1 due to a change I the current through the coil C_2.

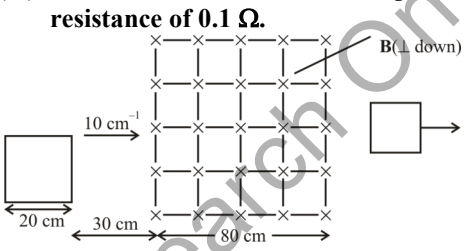
CBSE All India-2015

282. **A square loop of side 20 cm is initially kept 30 cm away from a region of uniform magnetic field of 0.1 T as shown in the figure. It is then moved towards the right with a velocity of 10 cm s^{-1} till it goes out of the field. Plot a graph showing the variation of**

(i) magnetic flux (ϕ) through the loop with time (t).

(ii) induced emf (ε) in the loop with time t.

(iii) induced current in the loop, if it has resistance of 0.1 Ω.



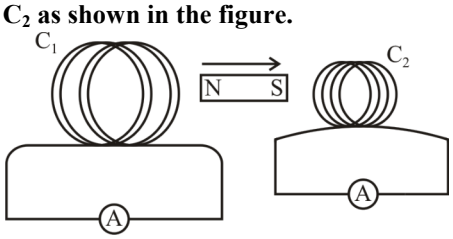
CBSE Delhi-2016

283. **(i) Derive an expression for the induced emf developed when a coil of N turns and area of cross-section A is rotated at a constant angular speed ω in a uniform magnetic field B.**

(ii) A wheel with 100 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magntic field. If the resultant magnetic field at that place is 4×10^{-4} T and the angle of dip at the place is 30°, find the emf induced between the axle and the rim of the wheel.

CBSE All India-2019

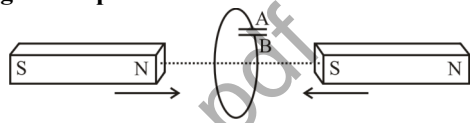
284. **A magnet is quickly moved in the direction indicated by an arrow between two coils C_1 and C_2 as shown in the figure.**



What will be the direction of induced current in each coil as seen from the magnet? Justify your answer.

CBSE Foreign-2011

285. **Predict the polarity of the capacitor in the situation described by adjoining as shown in figure. Explain the reason too.**



CBSE Delhi-2013, 2011

CBSE All India-2011

VI. AC Generator

Section-A (Multiple Choice Questions)

286. **The part of the AC generator that passes the current from the coil to the external circuit is :**

(a) field magnet (b) split rings

(c) slip rings (d) brushes

Tamil Nadu Board-September, 2016

Tamil Nadu Board-2015, 2016, 2017

Ans. (a) :

287. **In AC generator, induced emf is zero at time t = 0. The induced emf at time $\frac{\pi}{w}$ is____.**

(a) $-V_m$ (b) $+V_m$

(c) zero (d) $+2V_m$

Gujarat Board- March, 2019

Ans. (b) :

288. **The device which converts the mechanical energy into electric energy is–**

(a) D.C. motor (b) A.C. dynamo

(c) Transformer (d) Stater

MP Board-2015, 2021

Ans. (a) :

289. **The working of dynamo is based on the principle of.**

(a) Heating effect of current

(b) Electro - magnetic induction

(c) Induced magnetism

(d) Induced electricity

Bihar Board-2019, 2022

Ans. (b) :

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290. Instrument which converts mechanical energy into electrical energy is called

(a) induction coil (b) dynamo
(c) transformer (d) motor

Bihar Board-2022

Ans. (b) :

Section-B (Very Short Answer)

291. In a graphical variation of emf induced with time for the output of an AC generator, mark the peak value of emf induced and the time period.

ISC-2007

292. An ideal inductor does not consume any power even though both V and I are non-zero. Explain in brief.

ISC-2005, 2001

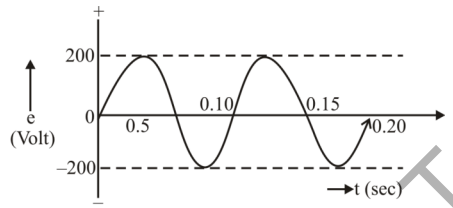
293. In an AC circuit, R = 4Ω, Z = 5Ω, V_{rms} = 200 V and I_{rms} = 1.5 A. Calculate the average power consumed over a full cycle.

ISC-2003

294. An AC generator generates an emf ε, where ε = 314 sin (50πt) volt. Calculate the frequency of the emf ε.

ISC-2017

295. Figure below shows emf 'e' generated by an AC generator versus time 't'



What is the frequency of emf ?

ISC-2010

296. An AC generator generates an emf 'ε' given by ε = 311 sin (100πt) volt. Then, find the rms value of the emf generated by the generator.

ISC-2009

297. The electric main in a house in marked 220 V-50 Hz. Write down the equation for the instantaneous voltage. The only variable in the equation should be 't'

ISC-2005

298. In which orientation of the armature coil of an ac generator relative to the magnetic field, will the induced emf be maximum?

CBSE-2020

Section-C (Short Answer)

299. In an AC generator, a rectangular coil of N turns and cross-section A is rotated in uniform magnetic field (B) with a uniform angular speed ω, then find the instantaneous value of the induced emf in it. Draw the necessary diagram.

Rajasthan Board-2022

300. What is a dynamo? Describe and A.C. dynamo under the following headings:

(i) Principle
(ii) Labelled diagram
(iii) Working.

MP Board-2018

301. Draw a schematic diagram of an ac generator. Explain its working and obtain the expression for the instantaneous value of the emf in terms of the magnetic field B, number of turns N of the coil of area A rotating with angular frequency ω. Show how an alternating emf is generated by a loop of wire rotating in a magnetic field.

CBSE-2019

302. State the basic principle behind the working of an ac generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

CBSE-2023

303. With the help of a labelled diagram, describe the principle and working of an ac generator. Hence, obtain an expression for the instantaneous value of the emf generated.

CBSE-2023

304. The coil of an ac generator consists of 100 turns of wire, each of area 0.5 m^2. The resistance of the wire is 100 Ω. The coil is rotating in a magnetic field of 0.8 T perpendicular to its axis of rotation, at a constant angular speed of 60 radian per second. Calculate the maximum emf generated and power dissipated in the coil.

CBSE-2023

205. Draw the labelled diagram of an AC generator. Briefly explain its working and obtain the expression for the emf produced in the coil.

CBSE-2020

306. (a) Write the principle of working of an ac generator. Derive the expression for the induced emf generated in it.

(b) Write the function of slip rings in an ac generator.

CBSE-2020

307. Mention one difference between an AC generator and a motor Draw a neat diagram of AC generator and indicate there (a) the coil, (b) the slip rings, (c) the axle, and (d) the carbon brasses.

Assam Board-2023

308. A stiff wire is bent into a semicircle of radius $\left(\frac{1}{\pi}\right)$m as shown in the figure. It is rotated about its diameter with 30 rev/s in a uniform magnetic field of 20× 10^{-3}T. Calculate the maximum value of e.m.f induced in the loop:

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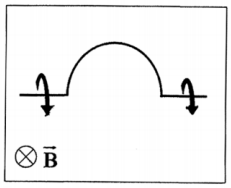

Goa Board-2023

309. With the help of a labelled diagram, derive the expression for instantaneous emf induced in an AC generator.

Karnataka Board-March, 2020

Section-D (Case-Based Questions)

310. The teacher of Sanjay's school took the students of Class-XII to NTPC, Korba for an educational tour. Presently power generation form coal and gas is done by NTPC Limited with an installed capacity of 43128 megawatt NTPC Limited is the largest company in the country. Seeing the device Sanjay asked to his teacher about the device. The teacher said that an alternating current generator is a device which converts mechanical energy into alternating current. Sanjay listened carefully to the teacher and asked questions about alternating current generator.
   (a) On what principle does the generator work?
   (b) Write the names of main parts of an alternating current generator.
   (c) Mention two values displayed by Sanjay and the teacher each.

Chhattisgarh Board-2022

Section-E (Long Answer)

311. Explain in detail the principle, construction and working of a single phase AC generator.

Tamil Nadu Board-March, 2016

312. Describe the principle construction and working of a single phase a.e. generator.

Tamil Nadu Board-2011, 2018

313. State the principle of an a.c. generator. With a simple diagram, describe the essential components of an a.c. generator.

Meghalaya Board-2015

314. Discuss the construction of an AC generator with the help of a simple diagram.

Meghalaya Board-2013

315. Give the principle construction and working of A. C. generator.

Haryana Board-2017
J&K Board-2017

316. With the help of a labelled diagram, explain the construction and working of an a.c. generator. Find an expression for e.m.f. produced by the generator.

J&K Board-2023

317. What is an A.C. generator? Draw a labelled diagram and describe the working of A.C. dynamo.

MP Board-2022

318. Derive an expression for the induced emf developed when a coil of N turns, and area of cross-section A, is rotated at a constant angular speed ω in a uniform magnetic field B.

CBSE-2019

319. State the working of AC generator with the help of a labeled diagram. The coil of an AC generator having N turns, each of area A, is rotated with a constant angular velocity ω. Deduce the expression for the alternating emf generated in the coil.
What is the source of energy generation in this device?

CBSE Delhi-2010

320. (i) State the principle on which AC generator works. Draw a labelled diagram and explain its working.
(ii) A conducting rod held horizontally along East-West direction is dropped from rest from a certain height near the Earth's surface. Why should there be an induced emf across the ends of the rod?
Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.

CBSE Foreign-2012

321. (i) Draw a labeled diagram of AC generator and state its working principle.
(ii) How is magnetic flux linked with the generator.
(iii) Derive the expression for maximum value of the induced emf and state the rule that gives the direction of the induced emf.
(iv) Show the variation of the emf generated versus time as the armature is rotated with respect to the direction of the magnetic fields.

CBSE Delhi-2014

322. Draw a schematic sketch of an AC generator describing its basic elements. State briefly its working principle. Show a plot of variation of
   (i) Magnetic flux and
   (ii) Alternating emf versus time generated by a loop of wire rotating generated by a loop of wire rotating I a magnetic field.

CBSE Delhi-2015

323. Derive an expression for instantaneous induced emf in an AC generator.

Karnataka Board-July, 2019

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07. Alternative Current

I. Voltage Applied To Resistor

Section-A (Multiple Choice Questions)

1. If the rms current in a 50 Hz a. c. circuit is 5A, at time t = 0 current I is 0. The value of current I at $t = \frac{1}{300}$ seconds is ____A.

(a) $\frac{5}{6}$ (b) $5\sqrt{\frac{3}{2}}$

(c) $5\sqrt{2}$ (d) $\frac{5}{\sqrt{2}}$

Gujarat Board-2023

Ans. (b) :

2. Inductive reactance _____.

(a) limits A. C current
(b) limits D.C. voltage
(c) limits D.C. current
(d) stores the A.C. current

Gujarat Board-2023

Ans. (a) :

3. A Peak voltage of an ac supply is 300V.____ V is the value of rms voltage.

(a) 212 (b) 173
(c) 423 (d) 269

Gujarat Board- August, 2020

Ans. (a) :

4. The phase difference between current and voltage in an ac circuit containing resistance only is

(a) 180° (b) 90°
(c) 60° (d) 0°

Jharkhand Board-2020
Haryana Board-2018

Ans. (d) :

5. The ratio of the peak and the r.m.s. voltage at any instant for an AC source is

(a) 1 : 2 (b) 2 : 1
(c) 1: $\sqrt{2}$ (d) $\sqrt{2}$: 1

Meghalaya Board-2013

Ans. (d) :

6. The phase difference between alternating e.m.f. and current in purely inductive circuite is

(a) 0 (b) π
(c) π/2 (d) π/4

Odisha Board-2022

Ans. (c) :

Section-B (Very Short Answer)

7. The equation of an alternating current is I = $3\sqrt{2}\sin\left(100\pi t + \frac{\pi}{4}\right)$A .Find the root mean square value and frequency of the current.

Jharkhand Board-2023

8. Represent graphically the alternating current.

Meghalaya Board-2015

9. Calculate peak value of current in a circuit if rms value is 100 A.

Haryana Board-2016

10. What is the phase difference between voltage and current in an AC circuit with pure resistor?

Chhattisgarh Board-2021

11. A light bulb of resistance 484Ω is connected with 220 V ac supply. Find peak value of current through the bulb.

Kerala Board-2021

12. How is r.m.s voltage of a.c related to peak value of a.c voltage?

Karnataka Board-March, 2014

13. The motion of copper plate is damped, when it is allowed to oscillate between the two poles of a magnet. What is the cause of this damping?

CBSE All India-2013

14. Write the relation between root mean square value and peak value of alternating current.

Uttarakhand Board-2020

15. The instantaneous emf of an ac source is given by E = 300 sin 314 t. What is the rms value of emf?

Uttarakhand Board-2023

Section-C (Short Answer)

16. Derive the relation $I_{r.m.s.} = \frac{Io}{\sqrt{2}}$ where $I_{r.m.s}$ and I_0 are the root - mean - square value and peak value of an alternating current.

Meghalaya Board-2023

17. (b) Derive and expression for root mean square value of alternating current for one full cycle.

Jharkhand Board-2020

18. (a) Derive and expression for average or mean value of alternating current for half cycle.

Jharkhand Board-2020

19. When an alternating emf e = 300 sin (100πt + π/6) volt is applied to a circuit, the current I through it is I = 5.0 sin (100πt –π/6) ampere. Then, find the phase difference between the emf and current.

ISC-2009

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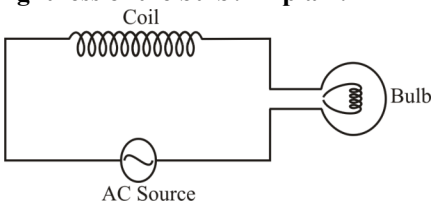
20. An AC source of emf E = 200 sin(100 πt) is connected across an inductor having resistance 100Ω and self inductance 2H. Calculate –
(i) Frequency of A.C.
(ii) Total impedance of the circuit.
(iii) Peak value of the current flowing through the circuit.

Assam Board-2015

21. What is meant by r.m.s value of a.c.? Derive the relation for root mean square value of a.c.

J&K Board-2016

22. An AC source is connected to a coil with negligible resistance and a bulb in series as shows in the figure. If an iron rod is gradually inserted in the coil, what happens to the brightness of the bulb? Explain.



Kerala Board-2017

23. An alternating voltage given by e = 140 sin (314.2t) is connected across a pure resistor of 50 Ω.
Calculate:
(i) the frequency of the source
(ii) the r.m.s. current through the resistor

Maharashtra Board-2023

II. Voltage Applied To Inductance

Section-A (Multiple Choice Questions)

24. What is the ratio of inductive and capacitive reactance in an ac circuit?
(a) $\omega^2 LC$ (b) LC^2
(c) $\frac{LC}{\omega^2}$ (d) $\omega^2 L$

CBSE-2023

Ans. (a) :

25. An alternating current $i = I_0 \sin(\omega t - \pi/2)$ is flowing in a circuit. The r.m.s. value of this current is:
(a) I_0 (b) I_0/ω
(c) $I_0/\sqrt{2}$ (d) ωI_0

Haryana Board-2018

Ans. (c) :

26. The power dissipated in a pure inductive circuit is :
(a) IR (b) I^2R
(c) Zero (d) None

Haryana Board-2016

Ans. (c) :

27. An inductive reactance of and inductor is _____.
(a) $\frac{1}{\omega C}$ (b) ωC
(c) $\frac{1}{\omega L}$ (d) ωL

Gujarat Board-March, 2022

Ans. (d) :

28. The phase difference between current and voltage in an A.C. circuit containing inductance only is
(a) 90° (b) 0°
(c) 180° (d) 60°

Jharkhand Board-2019

Ans. (a) :

29. An ideal inductor is connected across an AC source of voltage. The current in the circuit
(a) is ahead of the voltage in phase by π.
(b) lags voltage in phase by π.
(c) is ahead of voltage in phase by π/2.
(d) lags voltage in phase by π/2.

CBSE-2023

Ans. (d) :

Section-B (Very Short Answer)

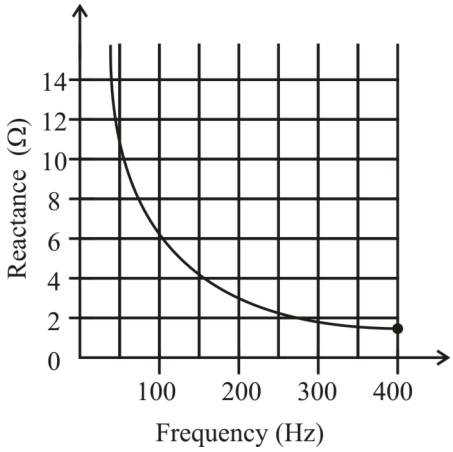
30. Obtain the expression for current in an A.C. circuit containing only inductor. (Draw necessary figure and graph)

Gujarat Board- May, 2021

31. A 44 mH inductor is connected to 220 V, 50 Hz ac supply. Determine the rms value of the current in the circuit.

Gujarat Board-March, 2022

32. The figure shows the graphical variation of the reactance of a capacitor with frequency of ac source.



(a) Find the capacitance of the capacitor.
(b) An ideal inductor has the same reactance at 100 Hz frequency as the capacitor has at the same frequency. Find the value of inductance of the inductor.

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(c) Draw the graph showing the variation of the reactance of this inductor with frequency.

CBSE-2020

33. Draw the graph showing variation of the value of the induced emf as a function of rate of change of current flowing through an ideal inductor.

CBSE-2020

34. What is the phase difference between A.C. e.m.f. and current in the following ?
Pure resistor and pure inductor.

Telangana Board-2015

35. A coil of self inductance 20 mH is connected to an a.c. source of 220V and of frequency 50Hz. What is the inductive reactance and r.m.s. current in the circuit?

Assam Board-2013

36. In a purely inductive AC circuit, the current leads the e.m.f. by phase $\pi/2$.
(Write True or False)

Odisha Board-2020

Section-C (Short Answer)

37. Obtain an expression for the current in an AC circuit containing a pure inductance only. Find the phase relationship between voltage and current. Draw the necessary graph.

Tamil Nadu Board-September, 2016

38. Calculate the energy stored in a coil of inductance 100 Henry due to flow of current 4 Ampere in it.

MP Board-2022

39. Obtain the relation for the current $I = I_o \sin(\omega t - \pi/2)$ for a pure inductor across which an alternating emf $\varepsilon = \varepsilon_0 \sin \omega t$ is applied.

ISC-2007

40. An ideal inductor of $\frac{5}{\pi}$ H inductance is connected to a 200 V, 50 Hz ac supply.
(a) Calculate the rms and peak value of current in the inductor.
(b) What is the phase difference between current trhough the inductor and the applied voltage ? How will it change if a small resistance is connected in series with this inductor in the circuit?

CBSE-2020

41. Prove that when an alternating voltage is applied to an inductor, the current through it lags behind voltage by an angle $\frac{\pi}{2}$.

Kerala Board-2021

42. For a purely inductive ac circuit , show that the current lags the voltage by a phase angle of $\frac{\pi}{2}$ radiance. Hence show that the power dissipated across the inductor is zero. Draw the phasor diagram.

Goa Board-2018

43. Show that voltage leads current by $\frac{\pi}{2}$, when A.C. voltage applied to pure inductance.

Karnataka Board-March, 2015

44. An inductance of $1/\pi$ H and 50 ohm resistance are added in series to 60 Hz, 200V alternating current source. Find the inductive - reactance, impedance and phase difference between voltage and current in the circuit.

Uttarakhand Board-2023

Section-D (Long Answer)

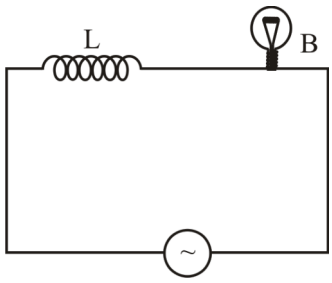
45. (b) Find out the phase relationship between voltage and current in a pure inductive circuit.

Tamil Nadu Board-2023

46. A 40W-110V bulb is to be used with 220V-50Hz AC. Calculate the inductance required for this purpose. 5

Assam Board-2016

47. An open coil inductor L of inductive reactance X_L is connected in series with a bulb B and an a.c. source. How would brightness of the bulb change when
(i) number of turns in the inductor are reduced ?
(ii) an iron rod is inserted into the interior of the inductor ?
(iii) a capacitor of capacitive reactance $X_C = X_L$ is connected in series in the circuit ?



Goa Board-2019

48. An AC EMF, $E = E_0 \sin\omega t$ is applied to a circuit containing pure inductance (L) only. Obtain the expression for current (I) in the circuit. Explain the phase relationship between E and I, and show it graphically.

Odisha Board-2023

49. A pure inductor of 25mH is connected to a source of 220V and 50 Hz. Find the inductive reactance, rms value of current and peak current in the circuit.

Karnataka Board-July, 2014

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III. AC Voltage Applied To Capacitor

Section-A (Multiple Choice Questions)

50. In an AC circuit having only capacitor, an electric current I _____ the voltage V in phase by _____

(a) leads, π (b) leads, $\frac{\pi}{2}$

(c) lags behind, π (d) lags behind $\frac{\pi}{2}$

Gujarat Board- July, 2022

Ans. (b) :

51. The phase difference between current and voltage in an a.c. circuit having capacitor only is:

(a) 0º (b) 90º

(c) 180º (d) 45º

J&K Board-2018

Ans. (b) :

52. An ac source is connected to a capacitor. The phase difference between applied voltage and the current flowing through it is :

(a) 0^0 (b) 90°

(c) 180° (d) 45°

Haryana Board-2018

Ans. (b) :

53. In an a.c. circuit, an alternating voltage e = 200 $\sqrt{2}$ sin 100 t volts is connected to a capacitor of capacitance 1 μF .The r. m. s. value of current in the circuit is

(a) 200 mA (b) 20 mA

(c) 10 mA (d) 100 mA

Meghalaya Board-2014

Ans. (b) :

54. The reactance X of an AC circuit containing pure capacitance C at frequency f is

(a) $X = 2\pi fC$ (b) $X = \frac{1}{2\pi fC}$

(c) $X = \frac{2\pi f}{C}$ (d) $X = \frac{2\pi C}{f}$

Odisha Board-2022

Ans. (b) :

Section-B (Very Short Answer)

55. Derive the expression for resultant capacitance, when capacitors are connected in series.

Tamil Nadu Board-2022

56. A 60 μF capacitor is connected to a 110 V, 60 Hz a.c. supply. Determine the root-mean square value of the current in the circuit.

Jharkhand Board-2018

57. What is capacitive reactance ? Write its Sl unit.

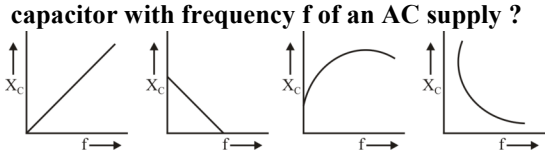
Chhattisgarh Board-2023

Bihar Board-2021

58. What is the capacitive reactance for a direct current? [1]

Chhattisgarh Board-2020

59. Which one of the following graph in figure represents variation of reactance X_C of a capacitor with frequency f of an AC supply ?



ISC-2012

60. An ac source of emf $V = V_0 \sin \omega t$ is connected to a capacitor of capacitance C. Deduce the expression for the current (I) flowing in it. Plot the graph of (i) V vs. ωt, and (ii) I vs. ωt

CBSE-2020

61. What is the impedance of a capacitor of capacitance C in an ac circuit using source of frequency n Hz?

CBSE-2020

62. Find the root mean square value of current through a capacitor of capacitance 10 μF, when connected to an a.c. source of 110 volt at 50 cycles/sec supply. What is its reactance?

Meghalaya Board-2018

63. An alternating source of e.m.f $E = E_0 \sin \omega t$ is applied to a circuit containing a capacitor only. Show that the current leads the e.m.f by $\frac{\pi}{2}$ radian.

Meghalaya Board-2023, 2019

64. A capacitor of capacitance 0.5μF is connected to a source of alternating e.m.f. of frequency 100Hz. What is the capacitive reactance? (π = 3.142)

Maharashtra Board-2018

65. A capacitor behaves as perfect conductor for high frequency a.c. Explain why ?

J&K Board-2020

66. How does capacitive reactance vary with frequency?

Karnataka Board-March, 2020

Section-C (Short Answer)

67. An alternating current circuit contains only a capacitor. Draw a circuit diagram and derive current, phase difference and capacitive reactance.

MP Board-2019

68. Obtain the relation $I = I_o \sin(\omega t + \pi/2)$ and $X_L = 1/\omega C$ for a pure capacitor across which an

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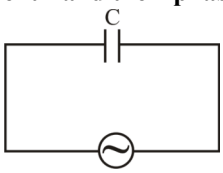
AC emf of $\varepsilon = \varepsilon_0 \sin \omega t$ is applied as shown in the figure. Draw a phasor diagram showing emf ε, current I and their phase difference ϕ.



ISC-2003

69. **(a) An ac source $v = v_m \sin \omega t$ is connected across an ideal capacitor. Derive the expression for the (i) current flowing in the circuit, and (ii) reactance of the capacitor. Plot a graph of current i versus ωt.**

CBSE-2023

70. **An ac voltage $v = v_m \sin \omega t$ (v_m = 310 V and f = 50 Hz) is connected to a pure capacitor of capacitance 15 μF. Calculate (i) the reactance of the capacitor, and (ii) the amplitude of the current. Write the expression of current through the capacitor as a function of time.**

CBSE-2023

71. **Show that the voltage and current are always in phase when a resistance is connected across an A.C. source. Draw the phasor diagram for it. To tune a radio over a frequency range of 800 kHz to 1200 kHz, inductance 'L' is kept constant and the corresponding capacitance is varied from C_1 to C_2. Compare C_1 to C_2.**

Goa Board-2023

Section-D (Long Answer)

72. **A resistor of 100Ω, a pure inductance coil of L = 0.5 H and capacitor are in series in a circuit containing an a.c source of 200 V, 50 Hz. In the circuit, current is ahead of the voltage by 30°. Find the value of the capacitance.**

Karnataka Board-July, 2015

IV. AC Voltage Applied To Series LCR Circuit

Section-A (Multiple Choice Questions)

73. **The power factor of L-R circuit is**

(a) $R + \omega L$ (b) $\frac{R}{\sqrt{R^2 + \omega^2 L^2}}$

(c) $R\sqrt{R^2 + \omega^2 L^2}$ (d) $\frac{\omega L}{R}$

Bihar Board-2022

Ans. (b) :

74. **In a RLC series circuit at resonance, the value of the power factor is :**

(a) Infinity (b) Zero

(c) $\frac{1}{\sqrt{2}}$ (d) 1

Tamil Nadu Board-2018

Ans. (d) :

75. **The instantaneous emf and current equations of an RLC series circuit are**

$$e = 200 \sin\left(\omega t - \frac{\pi}{6}\right)$$

$$i = 20 \sin\left(\omega t + \frac{\pi}{6}\right)$$

The average power consumed per cycle is:

(a) zero (b) 2000 W

(c) 1000 W (d) 500 W

Tamil Nadu Board-March, 2016

Ans. (c) :

76. **An LCR series circuit is connected to 240 V.A.C. supply. At resonance, the values of V_R, V_L and Vc are respectively:**

(a) 80 V, 80 V and 80 V

(b) 120 V, 60 V and 60 V

(c) 240 V, 120 V and 120 V

(d) 180 V, 40 V and 40 V

Tamil Nadu Board-2017

Ans. (c) :

77. **In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is:**

(a) Q (b) $\frac{Q}{2}$ (c) $\frac{Q}{\sqrt{3}}$ (d) $\frac{Q}{\sqrt{2}}$

Tamil Nadu Board-2023

Ans. (d) :

78. **For the current in LCR-circuit to be maximum :**

(a) $\omega^2 = LC$ (b) $\omega^2 = \frac{1}{Lc}$

(c) $\omega = \frac{1}{LC}$ (d) $\omega = LC$

J&K Board-2016

Ans. (b) :

79. **Current of $\frac{50}{\pi}$ Hz frequency is passing through an A.C. circuit having series combination of resistance R = 100 Ω and inductor L = 1H, then phase difference between voltage and current is ——.**

(a) 30° (b) 45°

(c) 60° (d) 90°

Gujarat Board- May, 2021, March - 2019

Ans. (b) :

80. **For L-C-R A.C. circuit resonance frequency is 600 Hz and frequencies at half power points are 550 Hz and 650 Hz. What will be the Q-Factor ?**

(a) 6 (b) $\frac{1}{3}$ (c) $\frac{1}{6}$ (d) 3

Gujarat Board- May, 2021

Ans. (a) :

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81. For LCR series circuit, $L = 2.0H, C = 32\mu F$ and $R = 10\Omega$, _____ is the Q value for this circuit.

(a) 395 (b) 279
(c) 40 (d) 25

Gujarat Board- August, 2020

Ans. (d) :

82. In an L-C oscillator circuit having a completely charged capacitor, with the passage of time___.

(a) The energy of the circuit continuously increases.
(b) The electric current increases gradually.
(c) The energy of the circuit continuously decreases.
(d) There is a continuous absorption of the electromagnetic wave.

Gujarat Board- March, 2019

Ans. (b) :

83. Which of the following combination should be selected for better tuning of an LCR a.c. circuit used for communication?

(a) R = 15 Ω, L = 3.5 H, C = 30 μF
(b) R = 25 Ω,L = 2.5 H, C = 45 μF
(c) R = 20 Ω, L = 1.5 H, C = 35 μF
(d) R = 25 Ω, L = 1.5 H, C = 45 μF

Gujarat Board-2023

Ans. (a) :

84. In series LCR circuit, the phase angle between supply voltage and current is

(a) $\tan\phi = \frac{X_L - X_C}{R}$ (b) $\tan\phi = \frac{R}{X_L - X_C}$
(c) $\tan\phi = \frac{R}{X_L + X_C}$ (d) $\tan\phi = \frac{X_L + X_C}{R}$

Jharkhand Board-2023

Ans. (a) :

85. A 100 Ω resistor is connected to a 220 V, 50 Hz ac supply. The r.m.s value of current in the circuit is

(a) 1.56 A (b) 1.56 mA
(c) 2.2 A (d) 2.2 mA

Jharkhand Board-2023

Ans. (c) :

86. In a series LCR circuit L = 8 H, C = 0.5 μF and R = 100 Ω. The resonant frequency of the circuit is

(a) $\frac{1000}{\pi}$ Hz (b) $\frac{500}{\pi}$ Hz
(c) $\frac{250}{\pi}$ Hz (d) $\frac{125}{\pi}$ Hz

Jharkhand Board-2018

Ans. (c) :

87. Which of the following statements about a series LCR circuit connected to an ac source is correct?

(a) If the frequency of the source is increased, the impedance of the circuit first decreases and then increases.
(b) If the net reactance ($X_L - X_C$) of circuit becomes equal to its resistance, then the current leads the voltage by 45°.
(c) At resonance, the voltage drop across the inductor is more than that across the capacitor.
(d) At resonance, the voltage drop across the capacitor is more than that across the inductor.

CBSE-2023

Ans. (b) :

88. An ac voltage $v = v_0 \sin \omega t$ is applied to a series combination of a resistor R and an element X. The instantaneous current in the circuit is $I = I_0 \sin(\omega t + \frac{\pi}{4})$. Then which of the following is correct ?

(a) X is a capacitor and $X_C = \sqrt{2}R$
(b) X is an inductor and $X_L = R$
(c) X is an inductor and $X_L = \sqrt{2}R$
(d) X is a capacitor and $X_C = R$

CBSE-2023

Ans. (d) :

89. An inductor, a capacitor and a resistor are connected in series across an ac source of voltage. If the frequency of the source is decreased gradually, the reactance of :

(a) both the inductor and the capacitor decreases.
(b) inductor decreases and the capacitor increases.
(c) both the inductor and the capacitor increases.
(d) inductor increases and the capacitor decreases.

CBSE-2023

Ans. (d) :

90. The phase difference between the current and the voltage in series LCR circuit at resonance is

(a) π (b) π/2
(c) π/3 (d) zero

CBSE-2020

Ans. (d) :

91. The selectivity of a series LCR a.c. circuit is large, when

(a) L is large and R is large
(b) L is small and R is small
(c) L is large and R is small
(d) L = R

CBSE-2020

Ans. (c) :

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92. In an L-C-R circuit, the capacitance is made one-fourth. What should be the corresponding change in the inductance, so that the circuit remains in resonance ?

(a) 8 times (b) $\frac{1}{4}$ time

(c) 2 times (d) 4 times

Meghalaya Board-2017

Ans. (d) :

93. A series L-C-R circuit having inductive reactance X_L and capacitive reactance X_c is tuned to is resonance. The impedance of the circuit now is

(a) R (b) $[R^2 + (X_L - X_C)^2]^{1/2}$

(c) $[R^2 + X_L^2 - X_C^2]^{1/2}$ (d) $X_L + X_C + R$

Meghalaya Board-2013

Ans. (a) :

94. Resonant frequency of LCR-resonant circuit is :

(a) $2\pi\sqrt{LC}$ (b) $2\pi/\sqrt{LC}$

(c) $\frac{1}{2\pi}\sqrt{LC}$ (d) $\frac{1}{2\pi\sqrt{LC}}$

J&K Board-2020

Ans. (d) :

95. The impedance of L-R circuit is

(a) $R^2 + \omega^2 L^2$ (b) $R + \omega L$

(c) $\sqrt{R + \omega L}$ (d) $\sqrt{R^2 + \omega^2 L^2}$

Bihar Board-2023

Ans. (d) :

96. The phase-difference between current and voltage in only capacitive alternating current circuit is

(a) 0° (b) 90°

(c) 180° (d) 45°

Bihar Board-2023

Ans. (b) :

Section-B (Very Short Answer)

97. Define resonant frequency of LCR series circuit.

Punjab Board-2018

98. A 100 Hz a.c. is flowing in a 14 mH coil. Find reactance of the coil.

J&K Board-2016

99. Calculate the inductive reactance of a 1mH coil for a frequency of 50 Hz.

J&K Board-2014, 2015

100. Find out value of power factor for following circuit.

(i) Purely capacitive circuit

(ii) Series LCR resonance circuit.

Rajasthan Board-2023

101. For circuit containing only Resistance represent AC current and voltage by rotating vectors (Phasors).

Gujarat Board- August, 2020

102. Explain LCR series resonance.

Gujarat Board- July, 2022

103. Deduce expressions for the resultant potential difference, impedance and current in a L-R alternating circuit. Draw graph to show the phase difference between the current and voltage.

MP Board-2015

104. What is the phase difference between current and voltage in a purely inductive alternating circuit? Write down the formula of inductive reactance of this circuit.

UP Board-2020

105. In a series L-C-R circuit, obtain an expression for the resonant frequency.

ISC-2017

106. Mention any two special properties of an L-C-R circuit at resonance.

ISC-2003

107. Alternating current flowing through a certain electrical device leads over the potential difference across it by 90°. State whether this device is a resistor, capacitor or an inductor.

ISC-2013

108. A series combination of an inductor (L), capacitor (C) and a resistor (R) is connected across an ac source of emf of peak value E_0 and angular frequency (ω). Plot a graph to show variation of impedance of the circuit with angular frequency (ω).

CBSE-2020

109. A resistor R and an inductor L are connected in series to a source of voltage $V = V_o \sin \omega t$. The voltage is found to lead current in phase by π/4. If the inductor is replaced by a capacitor C, the voltage lags behind current in phase by π/4. When L, C and R are connected in series with the same source,

Find the :

(i) average power dissipated and

(ii) instantaneous current in the circuit.

CBSE-2020

110. Write the impedance of a series LCR resonant circuit in terms of L, C and R.

CBSE-2020

111. What is the value of impedance of a resonant series LCR circuit?

CBSE-2020

112. Define 'quality factor' of a series LCR circuit at resonance. Suggest two methods to double the values of quality factor without changing the resonant frequency of the circuit.

CBSE-2020

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113. (c) If R and L represent resistance and inductance respectively then what is the dimension of $\frac{L}{R}$?

Assam Board-2015

114. A series LCR circuit is connected to a DC source. The magnitude of inductive reactance is_____.

Kerala Board-2017

115. Define 'quality factor' of resonance in L-C-R series circuit. Write down its mathematical relation.

Meghalaya Board-2023

116. A 0.1 H inductor, a 25×10^{-6} F capacitor and a 15Ω resistor are connected in series to a 120V, 50 Hz AC source. Calculate the resonant frequency.

Maharashtra Board-2022

117. In an Indian laboratory, a circuit running on low AC voltage is connected to the AC mains through an electrical device :
(i) Name the electrical device
(ii) If the electrical device is 100% efficient, state whether its input current will be greater or less that the output current.

Goa Board-2023

118. Write the expression for reactance of an inductor and a capacitor.

Telangana Board-2018

119. Write the condition for 'resonance' of series LCR circuit.

Karnataka Board-July, 2018

120. What is resonant frequency? Write the expression for resonant frequency?

Karnataka Board-July, 2020

Section-C (Short Answer)

121. LCR series circuit is connected to an ac source of voltage $V = V_0 \sin\omega t$. Using phasor diagrams obtain an expression for the impedance and the phase angle between the voltage and the current.

Goa Board-2018

122. A capacitor of unknown value and an inductor of 0.1 H and a resistor of 10Ω are connected in series to a 220V, 50Hz ac source. it is found that the power factor of circuit is unit. Calculate the capacitance of capacitor and maximum amplitude of current.

Punjab Board-2018

123. A source of alternating emf is connected to a series combination of a resistor R, an inductor L and a capacitor C. Obtain with the help of vector diagram and impedance diagram, an expression for :
(i) The effective voltage
(ii) The impedance
(iii) The phase relationship between the current and the voltage

Tamil Nadu Board-2016

124. Using Phasor diagram, derive an expression for impedance of an A.C circuit containing L, C and R joined in series.

Nagaland Board-2017

125. Show that the total energy of LC circuit in $V = V_E = \frac{1}{2}\frac{q^2_m}{C}$

Nagaland Board-2020

126. A series LCR circuit with R = 40Ω, L = 8H and C = 50μF is connected to a variable frequency 240 V ac supply.
(a) What is the angular frequency ω_0 of the source at which resonance occurs?
(b) Calculate the impedance and current at resonant condition.

Haryana Board-2018

127. A series LCR circuit with R = 20Ω, L = 5H and C = 80 μF is connected to a variable frequency 220 V ac supply.
(a) What is the angular frequency ω_0 of the source at which resonance occurs?
(b) Calculate the impedance and current at resonant condition.

Haryana Board-2018

128. A series LCR circuit with R = 30Ω, L = 8H and C = 50 μF is connected to a variable frequency 210 V ac supply.
(a) What is the angular frequency ω_0 of the source at which resonance occurs?
(b) Caculate the impedance and current at resonant condition.

Haryana Board-2018

129. (b) Define resonance frequency for a LCR circuit.

Haryana Board-2016

130. An inductance and a capacitance are connected in series with a source of alternating e.m.f. Derive an expression for resultant voltage, impedance and phase difference between current and voltage in alternating circuit.

MP Board-2015

131. Explain RC alternating circuit on the basis of following points.
(i) Resultant potential difference
(ii) Impedance of circuit
(iii) Phase difference between resultant voltage and current.

MP Board-2017

132. Determine the following in an alternating L-C-R circuit:
(a) Resultant voltage
(b) Impedance in the circuit
(c) Phase difference between the resultant voltage and current.

MP Board-2018

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133. Obtain expression for a.c. circuit $P_{av} \times V_{rms} \times I_{rms} \times \cos\phi$.

MP Board-2020

(c). If L is inductance, C is capacitance and R is resistance, then show that $\frac{L}{CR}$ has the unit of ohm.

UP Board-2018

(b) What is electrical resonance? Obtain an expression for the resonance frequency with the help of series resonance circuit.

UP Board-2020

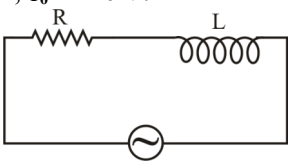
134. (a) Inductance L, capacitance C and resistance R are connected in series in alternative current circuit. Obtain the expression for the impedance of the circuit.

UP Board-2022

c. Define the formula for the resonant frequency in series L-C-R alternating current circuti.

UP Board-2023

18. In the R-L circuit shown in the given figure, the resistance, R = 30Ω, reactance, X_L = 40Ω and peak emf, ε_0 = 220 V.



Calculate

(i) the impedance Z.

(ii) phase difference between the emf and current.

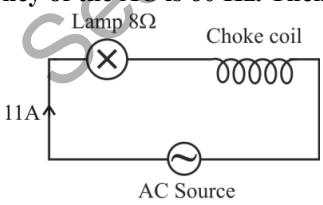
(iii) the peak current I_0 in circuit.

ISC-2004

135. A lamp with a resistance of 8Ω is connected to a choke coil as shown in the figure.

This arrangement is connected to an alternating source 110V.

The current in the circuit is 11 A. The frequency of the AC is 60 Hz. Then, find the



(i) impedance of the circuit.

(ii) value of inductive reactance of the choke coil.

ISC-2001

136. In a L-C-R circuit, all components connected in series, the emf and the current flowing in the circuit are given by the following equations.

$$\varepsilon_0 = 200\sin\left(314t + \frac{\pi}{6}\right)V, \quad I = 5\sin 314t A$$

Obtain

(i) the peak values of current and emf.

(ii) the frequency of the AC source.

(iii) the phase difference between current and emf.

ISC-2000

137. An alternating emf of 110 V is applied to a circuit containing a resistance R of 80Ω and an inductor L in series. The current is found to lag behind the supply voltage by an angle, $\theta = \tan^{-1}(3/4)$. Then, find the

(i) inductive reactance.

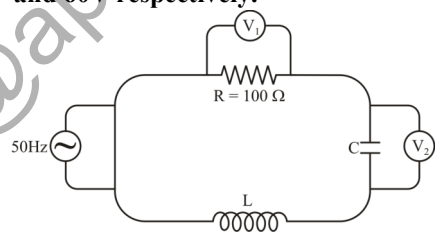
(ii) impedance of the circuit.

(iii) current flowing in the circuit.

(iv) if the inductor has coefficient of self-inductance of 0.1 H, what is the frequency of the applied emf ?

ISC-2014

138. (i) Figure below showx series a series L-C-R circuit connected to an AC source which generates an alternating emf of frequency of 50 Hz. The reading of voltmeters V_1 and V_2 are 80 V and 60V respectively.



Find

(a) the current in the circuit.

(b) the capacitance C of the capacitor.

(ii) At resonance, what is the relation between impedance of series L-C-R circuit and its resistance R ?

ISC-2013

139. A 50 μF capacitor, 30 Ω resistor and a 0.7 H inductor are connected in series to an AC supply which generate an emf e given by, e = 300 sin ISC-200t) V. Calculate peak value of the current flowing through the circuit.

ISC-2012

140. A 30 μF capacitor, 0.2H inductor and a 50 Ω resistor are connected in series to an AC source whose emf is given by E = 310 sin (314t), where E is in volt and t is in second. Calculate

(i) the impedance of the circuit.

(ii) peak value of current in the circuit.

ISC-2008

141. Find the inductance of a choke coil needed to run an arc lamp with an AC source of 100 V supply at 50 Hz. The arc runs at 10A current and has an effective resistance of 4Ω.

ISC-2004

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142. An alternating emf of frequency 50 Hz is applied to a circuit with a resistor of 20Ω, an inductor of 100 mH and a capacitor of 30 μF connected in series.

(i) What is the angle by which the current leads or lags the applied emf ?

(ii) Represent the voltage and the current in a vector diagram showing the phase angle.

ISC-2006

143. An AC circuit with resistance R, inductance L and capacitance C are connected in series. The value of C is adjusted for resonance. State any three properties of this circuit which hold true for resonance only. (Give the properties in words or equations, relating X_L, X_C, Z, R, ϕ, power etc).

ISC-2006

144. Plot a labelled graph showing variation in impedance Z of a series L-C-R circuit with frequency f of alternating emf applied to it. What is the minimum value of this impedance ?

ISC-2010

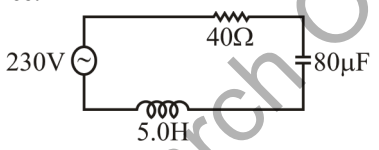
145. Obtain an expression for resonant frequency f_0 of a series L-C-R circuit.

ISC-2009

146. Draw the phasor diagram of a series LCR connected across an ac source $V = V_0 \sin \omega t$. Hence, derive the expression for the impedance of the circuit. Obtain the condition for the phase angle under which the current is (i) maximum, and (ii) minimum.

CBSE-2019

147. The figure shows a series LCR circuit connected to a variable frequency 230 V source.



(a) Determine the source frequency which drives the circuit in resonance.

(b) Calculate the impedance of the circuit and amplitude of current at resonance.

(c) Show that potential drop across LC combination is zero at resonating frequency.

CBSE-2019

148. A series LCR ac circuit has L = 2·0 H, C = 32 μF and R = 10 Ω.

(a) At what angular frequency of ac will it resonate?

(b) Calculate the Q value of the circuit.

CBSE-2020

149. A resistance R and a capacitor C are connected in series to an ac source $V = V_0 \sin \omega t$.

(a) Obtain the expression for the instantaneous current (I) in the circuit.

(b) Show graphically variations of V and I as a function of ωt.

CBSE-2020

150. A resistance R and a capacitor C are connected in series to a source $V = V_0$ is ω t. Find :

(a) The peak value of the voltage across the (i) resistance and

(ii) capacitor.

(b) The phase difference between the applied voltage and current. Which of them is ahead?

CBSE-2020

151. In series LCR circuit in which R = 3Ω, L = 25 mH and C = 800 μF a sinusoidal a.c voltage of peak value 250V is applied. Find

(i) frequency at which resonance occurs

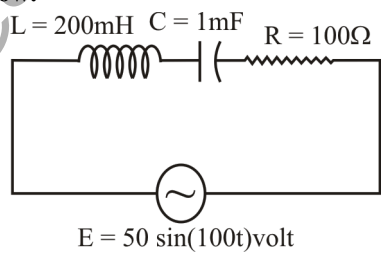
(ii) current in the circuit at resonant condition

Assam Board-2013

152. What is power factor of an LCR circuit? Explain on the basis of power factor that an ideal inductor is a Wattless component. 2

Assam Board-2015

153. Find the peak current in the circuit given below.



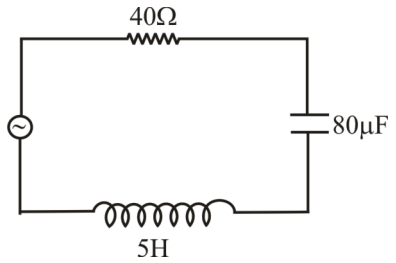
Assam Board-2015

154. (a) The S.I. unit of inductive reactance is

(i) Henry (ii) Ohms

(iii) Volt (iv) No unit

(b) Figure given below shows a series LCR circuit connected to a variable frequency source.



Determine the source frequency at resonance.

Kerala Board-2016

155. With the help of a phasor diagram, find an expression for impedance (Z) in a series L-C-R circuit.

Meghalaya Board-2019

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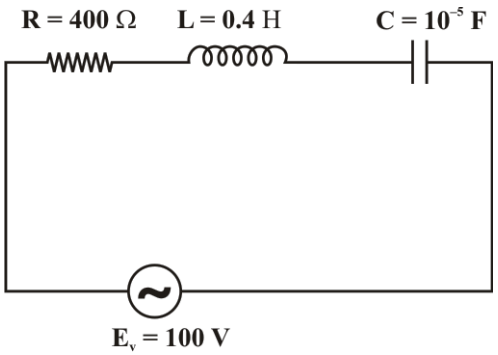
156. Write down the condition of resonance in series L-C-R circuit and hence find an expression for the resonant frequency.

Meghalaya Board-2019

157. An L-C-R circuit is connected to an a.c. generator as shown in the figure below:



If $\omega = 1000$ rad s^{-1}, find the impedance of the circuit.

Meghalaya Board-2015

158. Assuming expression for impedance in a parallel resonant circuit, state the conditions for parallel resonance. Define resonant frequency and obtain an expression for it.

Maharashtra Board-2019

159. Define resistance, reactance and impedance of a LCR circuit.

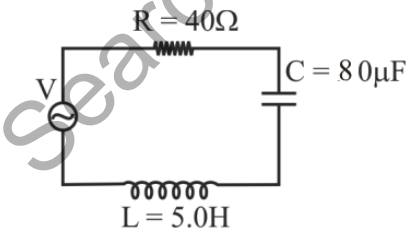
J&K Board-2011

160. Derive an expression for resonant frequency of series circuit containing inductor, capacitor and resistor.

Karnataka Board-July, 2014

161. Figure shows a series LCR circuit connected to a variable frequency source V as according to figure.

(i) Determine that source frequency which drives the circuit in resonance.



(ii) Obtain the impedence of circuit at the resonating frequency.

Uttarakhand Board-2022

Section-D (Case-Based Questions)

162. Write down the condition of resonance in a series L-C-R circuit and hence find an expression for the resonant frequency. Also draw the resonance curve in L-C- R circuit.

Meghalaya Board-2014

Section-E (Long Answer)

163. A source of alternating emf is connected to a series combination of a resistor R, an inductor L, and a capacitor C, Obtain with the help of a vector diagram and impedance diagram, an expression for (i) the effective voltage (ii) the impedance (iii) the phase relationship between the current and the voltage.

Tamil Nadu Board-2017

164. Define Impedance. Derive an expression for it in LCR circuit connected to a e. supply

J&K Board-2014, 2015

165. Explain L-C Oscillation. Write the expression for the frequency of L-C Oscillation.

J&K Board-2012

166. Derive an expression for impedance and phase angle for series LCR a.c. circuit. How does impedance differ from ohmic resistance?

J&K Board-2023

167. (a) Define average power of an AC circuit and derive an expression for average power in LCR circuit. What is the value of average power in a purely resistive circuit?

Nagaland Board-2020

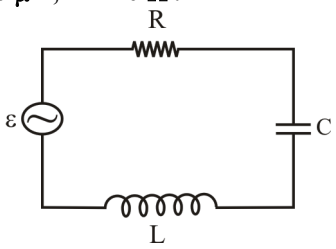
168. Write the voltage equation for L-C-R series AC circuit. Using analytical solution method derive equation for current and phase difference.

Gujarat Board- August, 2020

169. Write the differential equation for charge in L-C-R series A.C. circuit and obtain equation for complex current from it. 4

Gujarat Board- March, 2019

170. Figure shows a series LCR circuit connected to a variable frequency 230 V a.c. source. L = 5 H, C = 80 μF , R = 40 Ω .



(a) Determine the source frequency which derives the circuit in resonance.

(b) Obtain the impedance of the circuit and amplitude of current at the resonating frequency.

(c) Determine the rms potential drops across the three elements of the circuit.

(d) Show that the potential drop across the LC combination is zero at the resonating frequency.

Gujarat Board-2023

171. A series LCR circuit with L = 0.12H, C = 480 nF, R = 23 Ω is connected to 230 V variable frequency supply.

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(a) What is the source frequency for which current amplitude is maximum? Obtain the maximum value.
(b) What is source frequency for which average power absorbed by the circuit is maximum ? Obtain the value of maximum power?
(c) For which frequencies of the source is the power transferred to the circuit is half the power at resonant frequency? What is the current amplitude at these frequencies?
(d) What is the Q factor of the given circuit?

Gujarat Board-2023

172. Derive the differential equation for LC oscillations and explain the meaning of LC oscillations.

Gujarat Board- July, 2022

173. Define reactance and impedance in A.C. circuits. Derive expression for instantaneous current in a series L–C–R circuit if connected to an alternating emf.

Jharkhand Board-2019

174. What is resonant electrical circuit? What are its types? Find out an expression for resonant frequency for series L-C-R circuit.

MP Board-2012

175. For an A.C. circuit containing L-C-R establish the formula for impedance of the circuit and write the relationship between the alternating e.m.f. and current in each of the following case when:

(i) $\omega L > \frac{1}{\omega C}$

(ii) $\omega L < \frac{1}{\omega C}$

(iii) $\omega L = \frac{1}{\omega C}$

MP Board-2013

176. A resistance and inductance are connected in series with a source of alternating e.m.f. Derive an expression for resultant voltage, impedance and phase difference between current and voltage in alternating circuit.

MP Board-2014

177. In an alternating circuit containing an inductance. Capacitor and resistance are connected in series. Find :
(i) Resultant potential difference among three
(ii) Impedance of circuit
(iii) Phase difference between potential difference and current

MP Board-2020

178. Determine the following in the ……
(i) Resultant voltage
(ii) Impedance in the circuit
(iii) Phase difference between the resultant voltage and current.

MP Board-2021

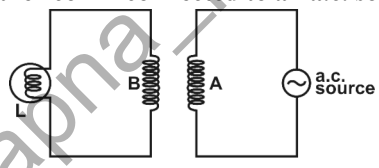
179. Describe the following points in an L-C-R circuit :
(1) Electrical circuit (2) Phasor diagram
(3) Resultant voltage (4) Impedance
(5) Phase difference

MP Board-2022

180. Describe an a.c. L-C-R circuit on the basis of the following points:
(i) Impedance of circuit
(ii) Phase difference
(iii) Expression for resonance frequency

Chhattisgarh Board-2018

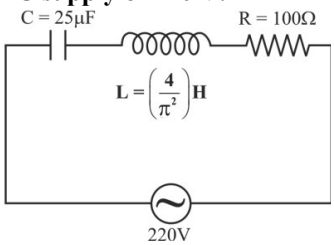
181.(a) A wire kept along north-south direction is allowed to fall freely. Will an e.m.f. be induced in the wire? State reason for your answer.
(b) A coil B is connected to a low-voltage bulb L as shown in the figure and is placed parallel to another coil A connected to an a.c. source.



Explain the reasons for the following observations :
(i) The bulb lights up
(ii) The bulb gets dimmer if the coil B is moved upwards
(c) State the condition for resonance to occur in a series L-C-R circuit and hence derive an expression for the resonance frequency.

NIOS-2013

182. (i) Figure below shows a capacitor C, an inductor L and a resistor R connected in series to an AC supply of 220 V.



Calculate
(a) the resonant frequency of the given L-C-R circuit.
(b) current flowing through the circuit.
(c) average power consumed by the circuit.
(ii) In a series L-C-R circuit, what is the phase difference between V_L and V_C, where V_L is the potential difference across the inductor and V_C is the potential difference across the capacitor ?

ISC-2015

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183. (a) In a series LCR circuit connected across an ac source of variable frequency, obtain the expression for its impedance and draw a plot showing its variation with frequency of the ac source.
(b) What is the phase difference between the voltages across inductor and the capacitor at resonance in the LCR circuit?
(c) When an inductor is connected to a 200 V dc voltage, a current of 1A flows through it. When the same inductor is connected to a 200 V, 50 Hz ac source, only 0.5 A current flows. Explain, why? Also, calculate the self inductance of the inductor.

CBSE-2019

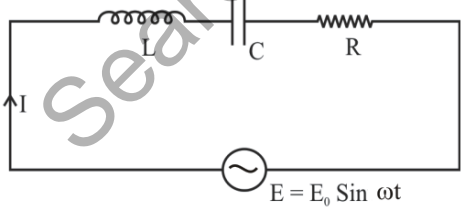
184. An inductor of self inductance L = 50mH is connected in series with a non inductive resistor of resistance R = 10Ω. A source of e.m.f. $\varepsilon = (100 \sin 50\pi t)$ Volt is connected in the circuit. Find the
(i) reactance of the coil
(ii) impedance of the circuit
(iii) rms voltage drop across the inductor.

Assam Board-2014

185. The current through an AC circuit depends on the magnitude of the applied voltage and impedance of the circuit.
(a) Write any two factors on which the impedance of a series LCR circuit depends.
(b) Draw and impedance diagram of a series LCR circuit and write the expression for the power factor from the diagram.
(c) A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3 Ω, L = 25.48 mH, and C = 796 μF. Find the impedance of the circuit.

Kerala Board-2020

186. (a) An alternating voltage is applied across on LCR circuit as shown below. Drawn the phasor diagram for the circuit. (1)



(b) Prove that an inductor offers easy path to d.c. and a resistive path to a.c. (1)
(c) In the above circuit if L = 100mH, C = 100μ F, R = 120 Ω and E = 30 sin (100t) find the
(i) impedance
(ii) reactance
(iii) peak current and
(iv) resonant frequency of the circuit

Kerala Board-2013

187. A fascinating behaviour of the series RLC circuit is the phenomenon of resonance.
(a) Explain Resonance in an LCR circuit.
(b) Draw a graphical representation of variation of current amplitude i_m with frequency ω.
(c) What do you mean by sharpness of resonance? Explain it.

Kerala Board-2014

188. Using the phasor diagram, derive an expression for the impedance of a series LCR circuit. What is the resonant condition in series LCR circuit?

Meghalaya Board-2021

189. Derive an expression for the impedance and phase angle of an LCR–series circuit. Hence write the condition for impedance to be maximum and minimum.

J&K Board-2019

190. An AC e.m.f. $\varepsilon = \varepsilon_0 \sin \omega t$ is applied to a circuit containing resistance R, inductance L and capacitance C in series. Write the expression for current in the circuit. Obtain the condition of resonance. In a series L-C-R circuit, R = 60Ω, L = 40 mH and C = 400μF.
Determine the resonant frequency.

Odisha Board-2020

191. A series LCR circuit contains a pure inductor of inductance 5.0 H, a capacitor of capacitance 20 μF and a resistor of resistance 40Ω.
a) Find the resonant frequency of the circuit.
b) Calculate the quality factor (Q-factor) of the circuit.
c) What is the impedance at resonant condition?

Karnataka Board-March, 2020

192. A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a series LCR circuit in which R = 3Ω, L = 25.48mH and C = 786μF. Find
a) Impedance of the circuit.
b) The phase difference between the voltage across the source and the current
c) The power factor.

Karnataka Board-March, 2015

193. Derive an expression for the impedance of a series LCR circuit, when an AC voltage is applied to it.

Karnataka Board-March, 2019

194. Arrive at the expression for the impedance of a series LCR circuit using phasor diagram method and hence write the expression for the current through the circuit.

Karnataka Board-July, 2018

195. A source of alternating emf of 220V –50Hz is connected in series with a resistance of 200 Ω an inductance of 100 mH and a capacitance of 30 μF. Does the current lead or lag the voltage and by what angle?

Karnataka Board-March, 2017

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196. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3Ω, L = 25.48 mH and C = 786 μF Find

(a) Impedance of the circuit,

(b) The phase difference between the voltage across the source and the current

Karnataka Board-July, 2019

197. A 20 Ω resistor, 1.5 H inductor and 35 μF Capacitor are connected in series with a 220 V. 50 Hz ac supply. Calculate the impedance of the circuit and also find the current through the circuit.

Karnataka Board-July, 2018

198. An AC source of 200 volt, 50 Hz is applied to a series LCR circuit in which R = 30Ω, L = 25mH and C = 790μF. Find (a) the impedance of the circuit and (b) current in the circuit.

Karnataka Board-July, 2020

199. Calculate the resonant frequency and Q-factor of a series L-C-R circuit containing a pure inductor of inductance 3H, capacitor of capacitance 27μF and resistor of resistance 7.4Ω.

Karnataka Board-March, 2014

200. Derive the condition for resonance in the L–C–R series alternating current circuit. Find the expression for resonant frequency.

Bihar Board-2023

VI. Power in AC Circuit : The Power Factor

Section-A (Multiple Choice Questions)

201. Q Factor is equal to _____.

(a) $\frac{\omega_r L}{R}$ (b) $\frac{1}{R}\sqrt{\frac{L}{C}}$

(c) $\frac{X_L}{R}$ (d) All the above

Tamil Nadu Board-2022, 2015

Ans. (b) :

202. The value of power factor for a purily capacitive circuit is:

(a) 1 (b) 0

(c) 2 (d) $\sqrt{2}$

Haryana Board-2018

Ans. (a) :

203. For circuits used for transporting electric power, a low power factor implies _____.

(a) small power loss in transmission

(b) remains constant in transmission

(c) power increases in transmission

(d) large power loss in transmission

Gujarat Board-2023

Ans. (d) :

204. The power factor at the time of resonance is _____.

(a) ∞ (b) 1

(c) 0 (d) 0.5

Gujarat Board-March, 2022

Ans. (b) :

205. Q Factor is given by _____

(a) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ (b) $Q = \frac{1}{R}\sqrt{\frac{C}{L}}$

(c) $Q = \frac{L}{R}\sqrt{\frac{1}{C}}$ (d) $Q = \frac{R}{L}\sqrt{\frac{1}{C}}$

Gujarat Board- July, 2022

Ans. (a) :

206. A voltage signal is described by :

$v = V_0$ **for** $0 \le t \le \frac{T}{2}$

$= 0$ **for** $\frac{T}{2} \le t \le T$

for a cycle. Its rms value is :

(a) $\frac{V_0}{\sqrt{2}}$ (b) V_0 (c) $\frac{V_0}{2}$ (d) $\sqrt{2}V_0$

CBSE-2023

Ans. (a) :

207. The power factor of a series LCR circuit at resonance will be

(a) 1 (b) 0

(c) 1/2 (d) $1/\sqrt{2}$

CBSE-2020

Goa Board - 2019

Ans. (a) :

208. In an alternating current circuit, the phase difference between current I and voltage is ϕ , then the Wattles component of current will be.

(a) I cos ϕ (b) I tan ϕ

(c) I sin ϕ (d) I $\cos^2$ ϕ

Bihar Board-2019, 2022

Ans. (c) :

209. The power factor of L – R circuit is-

(a) R + ωL (b) $\frac{R}{\sqrt{R^2+\omega^2L^2}}$

(c) $R\sqrt{R^2+\omega^2L^2}$ (d) $\frac{\omega L}{R}$

Bihar Board-2019, 2021

Ans. (b) :

210. Power in an alternating current circuit is

(a) $P_{av} = E_{r.m.s.}.I_{r.m.s.}\sin\phi$

(b) $P_{av} = E_{r.m.s.}.I_{r.m.s.}\cos\phi$

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(c) $P_{av} = \frac{E_{r.m.s.}}{I_{r.m.s.}} \sin\phi$

(d) $P_{av} = \frac{E_{r.m.s.}}{I_{r.m.s.}} \cos\phi$

Bihar Board-2021

Ans. (b) :

211. Inductive reactance is

(a) $X_L = \omega L$ (b) $X_L = \frac{1}{\omega L}$

(c) $X_L = \sqrt{\omega.L}$ (d) $X_L = \frac{1}{\sqrt{\omega.L}}$

Bihar Board-2021

Ans. (a) :

20. Impedance represents

(a) current (b) electromotive force

(c) resistance (d) power

Bihar Board-2021

Ans. (c) :

212. Inductive reactance is

(a) $X_L = 2\pi f L$ (b) $X_L = 2\pi f^2 L$

(c) $X_L = 2\pi f L^2$ (d) $X_L = 2\pi f^2 L^2$

Bihar Board-2022

Ans. (a) :

213. The power factor of choke coil is

(a) 90° (b) 1

(c) 0 (d) 180°

Bihar Board-2022

Ans. (c) :

Section-B (Very Short Answer)

214. Why can a d.c. ammeter not read an a.c. ?

J&K Board-2023

215. What is the basic cause of induced e.m.f.?

J&K Board-2023

216. Define quality factor.

Tamil Nadu Board-2011, 2018

217. How can the Q-factor of a resonant circuit be increased ?

Nagaland Board-2017

218. Using $P = V_{rms} I_{rms} \cos\delta$, discuss any two special cases for power consumed in an AC circuit.

Gujarat Board- March, 2019

219. What is Q-factor? Write its expression and write the conditions for its maximum value.

MP Board-2012

220. Prove for an a.c. circuit:

$P_{av} = V_{rms} \times I_{rms} \times \cos\phi$

MP Board-2012

221. Obtain expression for an a.c. circuit-

$P_{av} = V_{rms} \times I_{rms} \cos\phi$

MP Board-2015

222. What will be the power factor of alternating circuit containing -

(i) pure resistor

(ii) pure inductor ?

UP Board-2019

223. An ac voltage of 50 V having frequency 50 Hz is connected with a resistance of 50Ω and inductance 2.0 mH. Find the impedance of the circuit.

UP Board-2021

224. When an alternating emf, e = 300 sin (100πt + π/6) volt is applied to a circuit, the current I through it is I = 5.0 sin (100πt –π/6) ampere. Then, find the average power consumed by the circuit.

ISC-2009

225. Give the expression for the power factor in an L-R circuit in terms of the resistance R and the inductive reactance X_L.

ISC-2002

226. What is meant by wattless current ?

ISC-2000

UP Board-2020

227. What is the value of power factor in a series of L-C-R circuit at resonance ?

ISC-2009

228. An alternating current of frequency f is flowing through an ideal choke coil of self-inductance L. If V_0 and I_0 be the peak values of the voltage and current, then find the average power consumed, if any, by the choke coil.

ISC-2009

229. What is the power factor of a series L-C-R circuit ?

ISC-2008

230. Given three elements X, Y and Z to be connected across an ac source. With only X connected across the ac source, voltage and current are found to be in the same phase. With only element Y in the circuit, the voltage lags behind the current in phase by $\frac{\pi}{2}$, while with the element Z in the circuit, the voltage leads the current in phase by $\frac{\pi}{2}$.

(a) Identify the elements X, Y and Z.

(b) When all these elements are connected in series across the same source, (i) determine the power factor, and (ii) find out the condition when the circuit is in resonant state.

CBSE-2019

231. What is the value of power factor of a series LCR circuit at resonance?

CBSE-2020

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232. A circuit element is connected across an ac source. It is observed that the voltage across the element leads the current flowing throng it by a phase angle $\frac{\pi}{2}$ identify the circuit element.

CBSE-2020

233. An ac is passed through a series LCR circuit. What is the impedance of the circuit at resonance?

CBSE-2020

234. (a) Explain the term 'sharpness of resonance' in ac circuit.
(b) In a series LCR circuit, $V_L = V_C \neq V_R$. What is the value of power factor for this circuit?

CBSE-2020

235. An inductor L = 0.4 H, a capacitor C = 10 μF and a resistor R = 400 Ω are connected in series to an ac source V = 40 sin(1000 t + π/3) volt. Calculate the
(a) impedance of the circuit, and
(b) peak value of current.

CBSE-2020

236. The equation of an alternating current is I = 50 sin 100 t. Find the frequency.

Meghalaya Board-2018

237. How much power is consumed in a purely inductive and a purely capacitive a.c. circuit?

Meghalaya Board-2017

238. A 100 Ω resistor is connected to a 220 V, 50 Hz supply. Calculate.
(a) r.m.s value of current and
(b) net power consumed over the full cycle

Maharashtra Board-2023

239. A parallel L-C circuit comprises of a 5H inductor and 5μF capacitor. Calculate the resonant frequency of the circuit.

Maharashtra Board-2020

240. If the peak value of a.c. current is 4.24 A, what is its root mean square value?

Karnataka Board-July, 2018

241. What are impedance and reactance in alternating current circuit ?

Bihar Board-2022

242. What do you mean by power factor ?

Bihar Board-2022

243. What is 'wattless' current?

Karnataka Board-July, 2018

Section-C (Short Answer)

244. Define wattless current. In a circuit, when 100 volt e.m.f. is applied, one ampere current flows. If the phase difference between current and electromotive force is $\frac{\pi}{3}$, calculate
(i) power factor
(ii) average power in the circuit
(iii) root mean square value of wattless current.

Rajasthan Board-2011

245. A rectangular loop of size (l × b) carrying a steady current 'I' is placed in a uniform magnetic field $\vec{B}$. Prove that the torque $(\vec{\tau})$ acting on the loop is given by $\vec{\tau} = \vec{m} \times \vec{B}$, where $\vec{m}$ is the magnetic moment of loop.

Or

Show that the alternating current lags behind the voltage by phase (π/2) in an A.C circuit containing inductor only. Draw a phasor diagram representing the relation between them.

Nagaland Board-2021

246. Prove that for A.C. circuit:
$P_{av} = V_{r.m.s.} \times I_{r.m.s.} \cos\theta$

MP Board-2014

247. Prove that: $I_{rms} = \frac{I_o}{\sqrt{2}}$ where I_{rms} & I_o have usual meaning [4]

MP Board-2017

248. What is power in a.c circuit? Obtain an expression for average power in a complete cycle of a. c circuit.

Chhattisgarh Board-2022

249. Prove that a high frequency a.c. can pass through a pure capacitor but not through a pure inductor. When 200V d.c. is applied across a coil, a current of 2A flows through it. When 200V a.c. of 50 Hz is applied to the same coil, only 1 A flows through it. Calculate the resistance (R), impedance (Z) and inductance (L) of the coil.

NIOS-2015

250. The equations of current and voltage in a circuit are as follows:
i = 3.5 sin(628 t + π/6) ampere
v = 28 sin(628 t - π/6) volt
Find out (i) root mean square value of current, (ii) time period and (iii) phase difference between current and voltage.

UP Board-2023

251. A resistance of 150Ω and a capacitance of 15μF are connected in series with an AC source of 220 V. The peak value of the current is 0.20 A. Calculate the average power consumed in the circuit. If the capacitor is removed but the current is kept the same, what is the average power consumed in the resistor alone ?

ISC-2007

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252. **A voltage $v = v_m \sin \omega t$ applied to a series LCR circuit, drives a current in the circuit given $i = i_m \sin (\omega t + \phi)$. Deduce the expression for the instantaneous power supplied by the source. Hence, obtain the expression for the average power.**

CBSE-2019

253. **Define the terms 'power factor' and 'wattless current', giving the examples where power factor is maximum and the circuit where there is wattles current.**

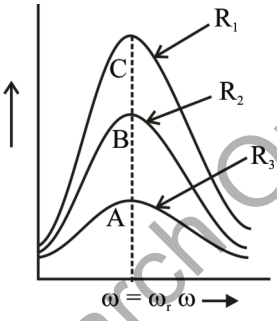
CBSE-2019

254. **(b) A 2 μF capacitor, 100 Ω resistor and 8H inductor are connected in series with an ac source. Find the frequency of the ac source for which the current drawn in the circuit is maximum.**

If the peak value of emf of the source is 200 V, calculate the (i) maximum current, and (ii) inductive and capacitive reactance of the circuit at resonance.

CBSE-2019

255. **(a) What do you understand by 'sharpness of resonance' for a series LCR resonant circuit? How is it related with the quality factor 'Q' of the circuit? Using the graphs given in the diagram, explain the factors which affect it. For which graph is the resistance (R) minimum?**

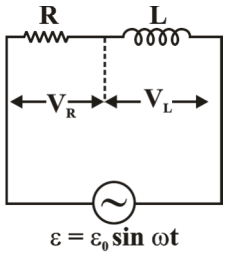


CBSE-2019

256. **(a) An ac circuit as shown in the figure has an inductor of inductance L and a resistor of resistance R connected in series. Using the phasor diagram, explain why the voltage in the circuit will lead the current in phase.**

(b) The potential difference across the resistor is 160 V and that across the inductor is 120 V. Find the effective value of the applied voltage. If the effective current in the circuit be 1.0 A, calculate the total impedance of the circuit.

(c) What will be the potential difference in the circuit when direct current is passed through the circuit ?



An ac circuit consists of a series combination of circuit elements X and Y. The current is ahead of the voltage in phase by $\frac{\pi}{4}$. If element X is a pure resistor of 100 Ω.

(a) name the circuit element Y.

(b) calculate the rms value of current, if rms value of voltage is 141 V.

(c) what will happen if the ac source is replaced by a dc source ?

CBSE-2019

257. **An alternating voltage of 220 V is applied across a device X. A current of 0.22 A flows in the circuit and it lags behind the applied voltage in phase by π/2 radian. When the same voltage is applied across another device Y, the current in the circuit remains the same and it is in phase with the applied voltage.**

(i) Name the devices X and Y and,

(ii) Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.

CBSE-2023

258. **(a) A resistor of 30 Ω and a capacitor of $\frac{250}{\pi}$ mF are connected in series to a 200 V, 50 Hz ac source. Calculate (i) the current in the circuit, and (ii) voltage drops across the resistor and the capacitor. (iii) Is the algebraic sum of these voltages more than the source voltage? If yes, solve the paradox.**

(b) A series LCR circuit with R = 20 Ω, L = 2H and C = 50 μF is connected to a 200 volts ac source of variable frequency. What is (i) the amplitude of the current, and (ii) the average power transferred to the circuit in one complete cycle, at resonance? (iii) Calculate the potential drop across the capacitor.

CBSE-2023

259. **A series LCR circuit with R = 20Ω , L = 2 H and C = 50 μF is connected to a 200 volts ac source of variable frequency. What is (i) the amplitude of the current, and (ii) the average power transferred to the circuit in one complete cycle, at resonance? (iii) Calculate the potential drop across the capacitor.**

CBSE-2023

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260. **A series combination of an inductor L, a capacitor C and a resistor R is connected across an ac source of voltage in a circuit. Obtain an expression for the average power consumed by the circuit. Find power factor for (i) purely inductive circuit, and (ii) purely resistive circuit.**

CBSE-2023

261. **A series RL circuit with R = 10Ω and L = $\left(\frac{100}{\pi}\right)$ mH is connected to an ac source of voltage V = 141 sin (100 πt), where V is in volts and t is in seconds. Calculate**

(a) impedence of the circuit
(b) phase angle, and
(c) voltage drop across the inductor

CBSE-2023

262. **A series CR circuit with R = 200Ω and C = (50/π)μF is connected across an ac source of peak voltage ε_0 = 100 V and frequency v = 50 Hz. Calculate (a) impedance of the circuit (Z), (b) phase angle (ϕ), and (c) voltage across the resistor.**

CBSE-2023

263. **A resistor of 50 Ω, a capacitor of $\left(\frac{25}{\pi}\right)$ μF and an inductor of $\left(\frac{4}{\pi}\right)$H are connected in series across an ac source whose voltage (in volt) is given by V = 70 sin (100 πt). Calculate**

(a) the net reactance of the circuit,
(b) the impedence of the circuit
(c) the effective value of current in the circuit

CBSE-2023

264. **How does the resistance differ from impedance ? With the help of a suitable phasor diagram, obtain an expression for impedance of a series LCR circuit, connected to a source v = v_m sin ωt.**

CBSE-2023

265. **Find the condition for resonance in a series LCR circuit connected to a source v = v_m sin ωt, where ω can be varied. Give the factors on which the resonant frequency of a series LCR circuit depends. Plot a graph showing the variation of electric current with frequency in a series LCR circuit.**

CBSE-2023

266. **Why is electrical energy transmitted at high voltage from a distant power generating station?**

Assam Board-2015

267. **Obtain an expression for the average power of an a.c. circuit.**

Meghalaya Board-2018

268. **Define:**

(a) Inductive reactance
(b) Capacitive reactance
(c) Impedance

Maharashtra Board-2022

269. **What is meant by Electric resonance? Where is it used?**

J&K Board-2021

Section-D (Long Answer)

270. **Derive an expression for average power of an a.c. circuit containing L, C and R. Hence define power factor.**

J&K Board-2018

271. **Define power in an A.C circuit and obtain an expression for the average power over a complete cycle in case of a circuit containing inductance, resistance and capacitance. What is meant by wattless current ?**

Nagaland Board-2018

272. **Calculate the resonant frequency and Q-factor (Quality factor) of a series L-C-R circuit containing a pure inductor of inductance 4H, capacitor of capacitance 27μF and resistor of resistance 8.4Ω.**

Karnataka Board-March, 2016

273. **Derive an expression for current i passing through an AC circuit containing only inductor L. Draw a phasor diagram and graph of *v* and i versus ωt. Explain instantaneous power and the average power. 4**

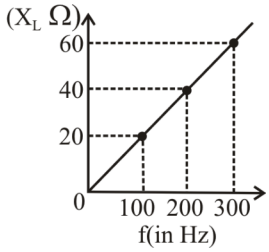
Gujarat Board- March, 2020

274. **In the case of an AC voltage applied to an inductor, derive formula for an electric current i at time t. Also, derive an expression for an average power over a complete cycle.**

Gujarat Board-March, 2022

275. **(a) Show that an ideal inductor does not dissipate power in an ac circuit.**

(b) The variation of inductive reactance (X_l) of an inductor with the frequency (f) of the ac source of 100 V and variable frequency is shown in the fig.



(i) Calculate the self-inductance of the inductor.

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(ii) When this inductor is used in series with a capacitor of unknown value and a resistor of 10 Ω at 300 s^{-1}, maximum power dissipation occurs in the circuit. Calculate the capacitance of the capacitor.

OR

(a) A conductor of length 'l' is rotated about one of its ends at a constant angular speed 'ω' in a plane perpendicular to a uniform magnetic field B. Plot graphs to show variations of the emf induced across the ends of the conductor with (i) angular speed ω and (ii) length of the conductor l.

(b) Two concentric circular loops of radius 1 cm and 20 cm are placed coaxially.

(i) Find mutual inductance of the arrangement.

(ii) If the current passed through the outer loop is changed at a rate of 5 A/ms. find the emf induced in the inner loop. Assume the magnetic field on the inner loop to be uniform.

CBSE-2020

276. A capacitor (c) and resistor (R) are connected in series with an ac source of voltage of frequency 50 Hz. The potential difference across C and R are respectively 120 V, 90V, and the current in the circuit is 3 A. Calculate

(i) The impedance of the circuit (ii) the value of the inductance, which when connected in series with C and R will make the power factor of the circuit unity.

CBSE-2019

277. (a) Define r.m.s. value or virtual value of an alternating current. Derive a relation between r.m.s. value and its peak value.

(b) An electrical device has the following ratings printed on it :

60W, 220V, 50 Hz.

What is the meaning of these numbers ?

Meghalaya Board-2021

278. An inductor and a bulb are connected in series to an AC source of 220V, 50Hz. A current of 11A flows in the circuit and phase angel between voltage and current $\frac{\pi}{4}$ radians. Calculate the impedance and induction of the circuit.

Karnataka Board-July, 2016

VI. Transformers

Section-A (Multiple Choice Questions)

279. A step - down transformer reduces the supply voltage from 220 V to 11 V and increases the current from 6 A to 100 A. Then its efficiency is :

(a) 0.12 (b) 1.2
(c) 0.9 (d) 0.83

Tamil Nadu Board-2022

Ans. (a) :

280. Transformer works on:

(a) AC only
(b) DC only
(c) Both AC and DC
(d) AC more effectively than DC

Tamil Nadu Board-2017

Ans. (a) :

281. Transformer works on principle of:

(a) Conservation of charge
(b) Mutual induction
(c) Rectification
(d) None of these

MP Board-2022
J&K Board-2018

Ans. (b) :

282. The core of a transformer is laminated so that

(a) rusting of the core may be prevented
(b) energy losses due to eddy currents may be minimised
(c) ratio of voltage in primary and secondary may be increased
(d) the weight of the transformer may be reduced

Nagaland Board-2021

Ans. (b) :

283. Astronomers have found that the electromagnetic waves of wavelength 21 cm are continuously reaching the earth's surface. The frequency of this radiation is —— .
[C =3×10^8 ms^{-1}]

(a) 1.43kHz (b) 1.43Mhz
(c) 1.43 GHz (d) 1.43 Hz

Gujarat Board- May, 2021

Ans. (c) :

284. A power transmission line feeds input power at 3300 V to a step down transformer with its primary windings having 2000 turns. What should be the number of turns in the secondary in order to get output power at 330V?

(a) 200 (b) 400
(c) 33 (d) 40

Gujarat Board- March, 2020

Ans. (a) :

285. A power transmission line feeds input power at 2300 V to a stepdown transformer with its primary winding having 4000 turns. What should be the number of turns in the secondary in order to get output power at 230 V.

(a) 4000 (b) 40
(c) 400 (d) 2300

Gujarat Board-2023

Ans. (c) :

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286. To serve which one of the following purposes, a laminated core is used in the construction of transforms?
(a) To minimize flux leakage
(b) To decrease the resistance of the windings
(c) To minimize effect of eddy currents
(d) To decrease hysteresis
Gujarat Board- July, 2022

Ans. (c) :

287. Which is used as a voltage regulator ?
(a) Transformer (b) Transistor
(c) Zener diode (d) Photodiode
MP Board-2022

Ans. (c) :

288. Choose the correct option ?
The loss of power in a transformer can be reduced by
(a) increasing the number of turns in primary coil.
(b) increasing AC voltage applied to primary coil .
(c) using a solid core made of steel.
(d) using a laminated core of soft iron.
ISC-2010

Ans. (d) :

289. A step-up transformer operates on a 230 V line and supplies current of 2 A to a load. The ratio of the primary and secondary windings is 1:25. The current in the primary coil is
(a) 12.5 A (b) 15A
(c) 25A (d) 50A
Meghalaya Board-2019

Ans. (d) :

290. Soft iron is used to make the core of transformer because of its _____.
(a) low coercivity and low retentivity
(b) low coercivity and high retentivity
(c) high coercivity and high retentivity
(d) high coercivity and low retentivity
Maharashtra Board-2023

Ans. (d) :

291. In a step - up transformer, number of turns in primary and secondary coils are N_1 and N_2 then
(a) $N_1 > N_2$ (b) $N_2 > N_1$
(c) $N_1 = N_2$ (d) $N_1 = 0$
Bihar Board-2019

Ans. (b) :

292. Copper loss is associated with which of the following instruments ?
(a) Ammeter (b) Voltmeter
(c) Galvanometer (d) Transformer
Bihar Board-2021

Ans. (d) :

293. In step - up transformer, the value of current in secondary coil compared to primary coil is
(a) equal (b) less
(c) more (d) none of these
Bihar Board-2023

Ans. (b) :

Section-B (Very Short Answer)

294. Laminated iron sheets are used to minimize ____ currents in the core of a transformer.
CBSE-2020

295. On what principle is transformer based
J&K Board-2015
Tamil Nadu Board-2015

296. Define efficiency of a transformer.
Tamil Nadu Board-2016

297. An ideal transformer has 460 and 40,000 turns in the primary and secondary coils respectively. Find the voltage developed per turn of the secondary coil if the transformer is connected to a 230V AC main.
Tamil Nadu Board-2023

298. Mention two points of difference between step up and step down transformer.
J&K Board-2022

299. Describe any three energy losses in transformers. How there can be minimized explain?
Rajasthan Board-2023

300. What is the rate of energy loss due to Hysteresis? In what form does this energy appear?
Rajasthan Board-2011

(xii) The working of a transformer is based upon
Haryana Board-2016

301. Write any four differences between step-up and step-down transformer.
MP Board-2015

302. Which device is used in series with a Fluorescent lamp in an AC circuit?
Chhattisgarh Board-2019

303. What is an ideal transformer ?
ISC-2016

304. For many purposes, it is necessary to change an alternating voltage from one value to another. This is done with a transformer.
(a) The basic principle behind a transformer is_____
(b) Give an expression for the voltage and current in a transformer.
Kerala Board-2014

305. What is a transformer ? State its principle.
Meghalaya Board-2021

306. Write the working principle of a transformer. How is it useful for long distance transmission?
Meghalaya Board-2023

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307. Distinguish between step-up and step-down transformer.

Maharashtra Board-2020

308. Why is the core of a transformer laminated ?

J&K Board-2020

CBSE Delhi-2013

309. Why does metallic piece become very hot when it is surrounded by a coil carrying high frequency alternating current?

Manipur Board-2022

CBSE Delhi-2014

310. Mention two sources of energy loss in transformer.

Karnataka Board-March, 2020

311. Mention one power loss in transformer.

Karnataka Board-July, 2018

312. What is a transformer? Mention any one sources of energy loss.

Karnataka Board-July, 2019

313. A power transmission line feeds input power at 2300V to a step-down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary in order to get output power at 230V?

Or

What is meant by Wattless current? Clarify.

Uttarakhand Board-2020

314. What is the principle of working of a transformer? Write any one reason for energy loss in transformer.

Uttarakhand Board-2019

315. What are eddy currents? Give its two applications.

Uttarakhand Board-2019

Haryana Board-2016

Assam Board-2016

CBSE All India-2012

316. What is transformer ratio?

AP Board-2020, 2022, 2023

317. What is the phenomenon involved in the working of a transformer?

AP Board-2021

Section-C (Short Answer)

318. With the help of labelled diagram, describe the principle, construction and working of a transformer.

Punjab Board-2018

319. Give three ways of reducing energy loss in transformer.

Manipur Board-2022

320. Explain the construction and working of transformer

Tamil Nadu Board-2022

321. What are the advantages and disadvantages of AC over DC?

Tamil Nadu Board-2023

322. In an ideal step-up transformer input voltage is 110V and current flowing in the secondary is 10 A . If transformation ratio is 10, Calculate output voltage, current in primary and input output power.

Gujarat Board- May, 2021

Gujarat Board- March, 2019

323. What is a transformer? Describe the principle, construction and working method of a transformer.

Jharkhand Board-2020

324. Write the causes of energy loss and ways to reduce them in transformer (any four).

MP Board-2014

325. How many types of energy loss in transformer, explain.

MP Board-2017

326. What is the principle of choke coil? Why is the current in the choke coil called wattles current? Write its application in current control.

MP Board-2018

327. A step-down transformer changes the transmitted line voltage from 11000 Volt to 440 Volt. The number of turns in the primary coil is 8000. Find the number of turns in the secondary coil.

MP Board-2022

328. (b) State the principle of working of a step-up transformer. Deduce the expression for the secondary to primary voltage in terms of the number of turns in the two coils.

NIOS-2015

329. What is the principle of transformer? Mention the difference between step-up and step-down transformers. Mention the causes of energy losses in transformers.

UP Board-2020

330. Illustrate the working principle of a transformer. Mention the energy losses occurring in transformer.

UP Board-2021

331. A transformer has 500 turns in its primary and 1000 turns in its secondary winding. The primary voltage is 200V and the load in the secondary is 100Ω. Calculate the current in the primary, assuming it to be an ideal transformer.

ISC-2002

332. What are four different types of energy losses in a transformer ? State how to reduce/minimise any one of them ?

ISC-2012

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333. The primary coil having N_p turns of an ideal transformer is supplied with an alternating voltage V_p. Obtain an expression for the voltage V_s induced in its secondary coil having N_s turns. Mention two main sources of power loss in real transformers.

CBSE-2023

334. The primary and the secondary coils of an ideal step-down transformer consist of 650 and 25 turns respectively. When the primary coil of this transformer is connected to 240 V mains, the current in the primary coil is 1.5 A. Calculate :

(a) the voltage across the secondary coil

(b) the current in the secondary coil

(c) the average power delivered to the output circuit

CBSE-2023

335. Explain the principle of the device with diagram, which is used to provide electricity at the proper voltage for household purposes.

Briefly discuss loss of energy in it due to flux leakage and its minimization.

CBSE-2020

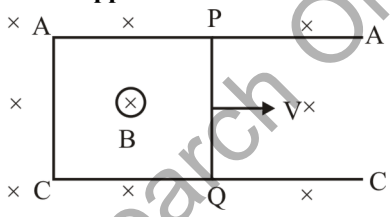
336. Explain with the help of a diagram, the working of a step-down transformer. Why is a laminated iron core used in a transformer?

CBSE-2020

337. With the help of a labelled diagram, explain the working of a step-up transformer. Give reasons to explain the following :

(I) The core of the transformer is laminated.

(ii) Thick copper wire is used in windings.



CBSE-2020

338. In a step-up voltage transformer, explain giving reasons, the following facts :

(a) The output current is less than the input current.

(b) The iron core is laminated.

(c) The input power is more than the output power.

CBSE-2020

339. What is step up and step down transformer? To transfer electric energy from generating station initially step up transformer is used. Why?

Assam Board-2013

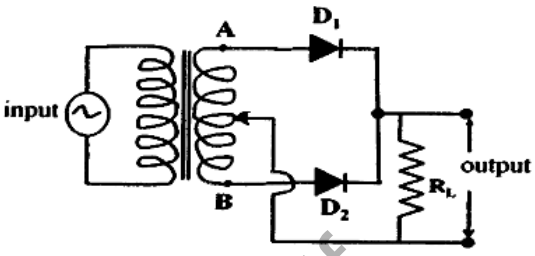
340. State the working principle of a transformer. What is hysteresis loss in transformer?

Assam Board-2016

341. Explain the principle and theory of a transformer. Why is the core of a transformer laminated ?

Meghalaya Board-2017

342. Refer the given circuit diagram :



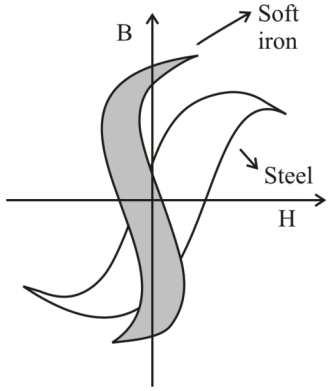
(a) Identify the given circuit

(b) Which end of the secondary of the transformer should be positive with respect to the centre tap, to forward bias diode D_2 ?

(c) How does the output voltage change if the amplitude of input voltage is increased ?

Goa Board-2023

343. Hysteresis loops for two materials soft iron and steel are shown in the figure below. The area of hysteresis loop for soft iron is smaller than that for steel.



(i) Which material has greater retentivity ?

(ii) Which material has larger coercivity ?

(iii) If both the materials are to go through repeated cycles of magnetisation which materail will dissipate greater heat energy ?

Goa Board-2019

344. Mention the three types energy loss in a transformer.

Karnataka Board-March, 2019

345. What is transformer? Mention two sources of energy loss in a transformer.

Karnataka Board-March, 2016, 2017

Karnataka Board-July, 2016

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346. What is a transformer? Mention two sources of energy loss in a transformer.

Karnataka Board-March, 2016

347. With diagram, explain the working of transformer.

Karnataka Board-July, 2016

Karnataka Board-March, 2014

348. What is the principle behind the working of a transformer? Mention any two sources of energy loss in transformer.

Karnataka Board-July, 2015

Section-D (Case-Based Questions)

349. Rajat walked bare foot to replace the fuse wire in kit-kat fitted with the alternating current supply mains for his house. Suddenly he screamed and fall on the floor. His son Rakesh heard the cries and rushed to the place with shoes on. He took a wooden baton and used it to switch off the mains supply.

Answer the following questions on the basis of above paragraph :

(i) The value of domestic alternating potential is 220 Volts. What will be its peak value.

(ii) How is wattless current obtained in a.c. circuit ?

(iii) Write the values displayed by Rakesh. (Any two)

Chhattisgarh Board-2023

350. The teacher of Dheeraj's school took the students to the power plant for an educational tour. The teacher said that in the form of alternating current, the transmission of electric energy is done in cities for such long distances. Transformer is used for this transmission. Dheeraj listened carefully to the teacher and asked questions about transformer.

(i) On what principle does the transformer work?

(ii) Write two difference between step-up and step-down transformer.

(iii) Mention two values displayed by Dheeraj and the teacher each.

Chhattisgarh Board-2022

351. The teacher of Pradeep's school took the students to the power plant for an educational tour. The teacher said that in the form of alternating current, the transmission of electrical energy is done in cities for such long distances. The alternating current is raised to higher voltages and the voltages are reduced to operate the devices at receptive location in cities. This result in very little loss of energy. Pradeep listened carefully to the teacher and asked her questions about using the alternating current in more or less voltage.

(i) Name the device to convert the alternative voltage to higher or lower value.

(ii) Mention the causes of power loss in this device.

(iii) Mention the two values displayed by Pradeep and the teacher

Chhattisgarh Board-2021

352. Vijay walked bare foot to replace the fuse wire in kit-kat fitted with the alternating current supply mains for his house. Suddenly he screamed and fall on the floor. His son Amit heared the cries and rashed to the place with shoes on. He took a wooden baton and used it to switch off the mains supply.

Answer the following questions on the basis of above paragraph :

(i) What is the voltage and frequency of mains supply in India?

(ii) These days most of the electrical devices we use require A.C. voltage. Why?

(iii) Write the values displayed by Amit (any two).

Chhattisgarh Board-2020

353. The teacher of Harshit's school took the students on a study trip to a power generating station, located nearly 200 km away from the city. The teacher explained that electrical energy is transmitted over a long distance to their city, in the form of alternating current (AC) raised to a high voltage. At the receiving end in the city, the voltage is reduced to operate the devices. As a result, the power loss is reduced. Harshit listened to the teacher and asked questions about how the AC is converted to a higher or lower voltage.

(i) Name the device used to change the alternating voltage to a higher or lower value.

(ii) State causes for power dissipation in this device.

(iii) Write two values each shown by the teacher and Harshit.

Chhattisgarh Board-2019

354. What is the principle on which a transformer is based? With a simple diagram, briefly describe the working of a transformer.

Meghalaya Board-2014

Section-E (Long Answer)

355. Describe the principle, construction and working of a transformer.

Bihar Board-2019

J&K Board-2016, 2019

Haryana Board- 2016

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356. With the help of a labelled diagram, explain the working of a transformer.
Write any two sources of energy loss in a transformer.
Nagaland Board-2018

357. Explain the principle and working of a transformer.
Haryana Board- 2017

358. A small town with a demand 800kW of electric power at 220V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the wire line carring power is 0.5 Ω per km. The town gets power from the line through a 4000-220 V step down transformer at a sub-station in the town.
(a) Estimate the line power loss in the form of heat.
(b) How much power must the plant supply, assuming there is negligible power loss due to leakage?
(c) Characterise the step up transformer at the plant.
Gujarat Board- August, 2020

359. Describe a transformer under the following headings :
(i) Labelled diagram
(ii) Principle
(iii) Formula of transformer ratio
(iv) Any two reasons of energy loss in transformer.
MP Board-2019

360. What is transformer? Write its principle and its kinds and prove that
$$\frac{n_3}{n_p} = \frac{E_s}{E_p} = \frac{I_P}{I_N} = K$$
where K is the transformer ratio.
MP Board-2021

361. What is Transformer ? Describe its principle and different types of energy losses in it.
MP Board-2023

362. Describe a transformer on the basis of the following points : [2+3+1=6]
(i) Types and labelled diagram of transformer
(ii) Working method and principle
(iii) Any two applications
Chhattisgarh Board-2018

363. (a) a 250 V, 500 W electric mixer is connected to a 125 V ac power line through an ideal transformer. Calculate :
(i) the turns ratio of the transformer
(ii) the current drawn from the power line
(b)
(i) Is the transformer step up transformer or a step down transformer ?
(ii) How will a 250 V, 1 KW bulb behave when it replaces the mixer in the case (a) ?
NIOS-2022

364. What is the principle of transformer ? A step-down transformer converts 1100 volt to 110 volt of a transmission line voltage. The number of turn in primary coil is 2000. The efficiency of the transformer is 80% and the output power is 4000 watt. Calculate the following :
(i) the number of turns in the secondary
(ii) the input power
UP Board-2018

365. (a) Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write four source of energy loss in this device.
(b) A small town with a demand of 1200 kW of electric power at 220 V is situated 20 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5Ω per km. The town gets the power from the line through a 4000-220 V step-down transformer at a sub-station in the town. Estimate the line power loss in the form of heat.
CBSE-2019

366. Explain briefly with the help of a labelled diagram the basic principle of the working of an a.c. generator. Give two reasons for energy loss in an actual transformer. 3+2 = 5
Assam Board-2014

367. (a) Working principle of transformer is
(i) mutual induction (ii) motional emf
(iii) resonance (iv) LC oscillations
(b) Write any one difference between step-up and step-down transformer.
(c) A power transmission line feeds input power at 3300 V to a step-down transformer with its primary windings having 6000 turns. What should be the number of turns in the secondary in order to get output power at 220 V ?
Kerala Board-2021

368. What is a Transformer? Explains its theory and discuss its main uses.
J&K Board-2021

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08. Electromagnetic Wave

I. Displacement Current

Section-A (Multiple Choice Questions)

1. Which of the following is an electromagnetic wave ?
(a) β-rays (b) γ-rays
(c) α-rays (d) All of the above
Tamil Nadu Board-2022

Ans. (b) :

2. Charging current for a capacitor is 0.2 A, find the displacement current.
(a) Zero (b) 0.2 A
(c) 0.4 A (d) 0.1 A
Tamil Nadu Board-2023

Ans. (b) :

3. Due to which one of the following reasons, Maxwell's displacement current is generated?
(a) Due to conduction of electric charge
(b) Due to time-varying electric field
(c) Due to decrease in the magnetic field
(d) Due to constant electric field
Gujarat Board- July, 2022

Ans. (b) :

4. Displacement current exists only when
(a) electric field is changing.
(b) magnetic field is changing.
(c) electric field is not changing.
(d) magnetic field is not changing.
CBSE-2020

Ans. (a) :

5. Which of the following laws was modified by Maxwell by introducing the displacement current?
(a) Gauss's law (b) Ampere's law
(c) Biot-Savart's law (d) None of these
Uttarakhand Board-2023

Ans. (b) :

Section-B (Very Short Answer)

6. Differentiate between conduction current and displacement current.
CBSE-2020

7. What is displacement current ?
Tamil Nadu Board-2018, 2022
Assam Board-2014
Karnataka Board-March, 2016, 2017, 2020
Nagaland Board-2018
Karnataka Board-July, 2015

8. What is displacement current ? Write the expression for Ampere-Maxwell law.
Nagaland Board-2020
J&K Board-2012

9. What is a displacement current ? How is it different from a conduction current ?
OR
What is meant by the term 'displacement current' ? Briefly explain how this current is different from a conduction current.
CBSE-2023

10. How is the changing electric field between the plates of a parallel plate capacitor during its charging, related to the idea of displacement current?
Assam Board-2017

11. Out of the four Maxwell's equations, which equation establishes the non-existence of magnetic monopole?
Assam Board-2015

12. The charging current for a capacitor is 0.6 A. What is the displacement current across its plates?
AP Board-2020

Section-C (Short Answer)

13. Define displacement current. What role does it play while charging a capacitor by dc source. Is the value of displacement current same as that of the conduction current? Explain.
CBSE-2019

14. How is the equation for Ampere's circuital law modified in the presence of displacement current ? Explain.
CBSE-2019

15. Prove that the average energy density of the oscillating electric field is equal to that of the oscillating magnetic field.
CBSE-2019

II. Electromagnetic Wave and Its Characteristics, Transverse Nature of EM Wave

Section-A (Multiple Choice Questions)

16. Electromagnetic waves are :
(a) May be transverse or longitudinal
(b) Transverse
(c) Neither transverse nor longitudinal
(d) Longitudinal
UP Board-2019
Tamil Nadu Board-2011, 2016, 2018

Ans. (b) :

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17. In an electromagnetic wave :
(a) power is equally transferred along the electric and magnetic fields.
(b) power is transmitted in a direction perpendicular to both the fields.
(c) power is transmitted along electric field.
(d) power is transmitted along magnetic field.

Tamil Nadu Board-September, 2016

Ans. (b) :

18. Which one of the following is not an electromagnetic wave?
(a) X - rays
(b) γ - rays
(c) Ultra Violet rays (UV rays)
(d) β - rays

Tamil Nadu Board-September, 2016
Uttarakhand Board-2022

Ans. (d) :

19. In an electromagnetic wave, the phase difference between electric field $\vec{E}$ and magnetic field $\vec{B}$ is:
(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$
(c) π (d) zero

Tamil Nadu Board-March, 2016

Ans. (d) :

20. Electromagnetic waves are produced by
(a) a charge at rest (b) acceleratiny charge
(c) an electric field (d) a magnetic field

Nagaland Board-2021

Ans. (b) :

21. Which of the following are electromagnetic waves?
(a) Sound waves (b) α-rays
(c) β-rays (c) γ-rays

Haryana Board-2018

Ans. (d) :

22. Radio waves reflected from which layer of atmosphere?
(a) Mesosphere? (b) Chromosphere
(c) Ionosphere (d) None

Haryana Board-2018

Ans. (c) :

23. The frequency of an electromagnetic wave is 30 MHz. What is its wavelength?
(a) 30 m (b) 3 m
(c) 100 m (d) 10 m

Haryana Board-2018

Ans. (d) :

24. The frequency of an electromagnetic wave is 10 MHz. What is its wavelength?
(a) 10 m (b) 3 m
(c) 300 m (d) 30 m

Haryana Board-2016

Ans. (d) :

25. A plane electromagnetic wave of frequency 25 MHz travel in free space along the X- direction. At a particular point in space and time. $\vec{E} = 6.3\hat{j}Vm^{-1}$.Value of $\vec{B}$ at this point will be____.
(a) $2.1\times10^{8}\hat{k}T$ (b) $2.1\times10^{-8}\hat{j}T$
(c) $2.1\times10^{-8}\hat{k}T$ (d) $2.1\times10^{8}\hat{j}T$

Gujarat Board- August, 2020

Ans. (c) :

26. The maximum value of $\vec{E}$ in an electromagnetic wave is equal to 1.8 Vm^{-1}. Thus the maximum value of $\vec{B}$ is.....
(a) 6×10^{-8} T (b) 3×10^{-6} T
(c) 6×10^{-9} T (d) 2×10^{-10} T

Gujarat Board- March, 2019

Ans. (c) :

27. For a given electromagnetic waves the magnitude of electric field is 6.6 V/m at a point in space. The magnitude of magnetic field at this points is ____T.
(a) 2.1×10^{-8} (b) 6.6×10^{-8}
(c) 19.8×10^{-8} (d) 2.2×10^{-8}

Gujarat Board-2023

Ans. (d) :

28. Which one of the following electromagnetic wave is of minimum wavelength?
(a) Ultraviolet rays (b) X - rays
(c) Gamma rays (d) Infrared

Gujarat Board-March, 2022

Ans. (c) :

29. By which one of the following equation the magnitudes of electric and magnetic fields in an electromagnetic wave are related?
(a) $E_0 = \frac{B_0}{C}$ (b) $B_0 = \frac{E_0}{C}$
(c) $E_0 = \frac{B_0^2}{2C}$ (d) $B_0 = \frac{E_0^2}{2C}$

Jharkhand Board-2018
Gujarat Board- July, 2022

Ans. (b) :

30. Which of the following electromagnetic waves has the greates frequency ?
(a) Radio waves (b) Ultraviolet rays
(c) Infrared rays (d) γ-rays

Jharkhand Board-2023

Ans. (d) :

31. Electromagnetic waves can be deflected by
(a) electric field only
(b) magnetic field only
(c) both electric and magnetic fields
(d) none of these

Jharkhand Board-2020

Ans. (d) :

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32. The formula for the velocity of electromagnetic waves in vacuum is given by :

(a) $c = \sqrt{\mu_o \varepsilon_o}$ (b) $c = \frac{1}{\sqrt{\mu_o \varepsilon_o}}$

(c) $c = \sqrt{\frac{\mu_o}{\varepsilon_o}}$ (d) $c = \sqrt{\frac{\varepsilon_o}{\mu_o}}$

MP Board-2014

Ans. (b) :

33. The wave used in telecommunication are

(a) Infra red (b) Ultraviolet
(c) Micro waves (d) Cosmic rays

MP Board-2015

Ans. (c) :

34. The waves used in television network are–

(a) Microwaves
(b) Ultra high frequency radio waves
(c) Gamma rays (d) Ultra violet rays

MP Board-2021

Ans. (a) :

35. Electromagnetic waves are produced by :

(a) an accelerated charge
(b) a static charge
(c) moving a charge with uniform velocity
(d) a current carrying conductor

MP Board-2022

Ans. (a) :

36. Electromagnetic waves are not produced

(a) by stationary charge
(b) by accelerated charge
(c) by decelerated charge
(d) by a charge in uniform circular motion.

UP Board-2021

Ans. (a) :

37. The electromagnetic waves used in radar systems are :

(a) Infrared waves (b) Ultraviolet rays
(c) Microwaves (d) X-rays

CBSE-2023

Ans. (c) :

38. Electromagnetic waves of wavelength of the order of a few meters were first produced and detected in the laboratory by :

(a) J.C. Maxwell (b) J.C. Bose
(c) H.R. Hertz (d) G. Marconi

CBSE-2023

Ans. (c) :

39. The ratio of the magnitudes of the electric field and magnetic field of a plane electromagnetic wave is

(a) 1 (b) $\frac{1}{c}$

(c) c (d) $\frac{1}{c^2}$

CBSE-2023

Ans. (c) :

40. $\vec{E}$ and $\vec{B}$ represent the electric and the magnetic field of an electromagnetic wave respectively. The direction of propagation of the wave is along

(a) $\vec{B}$ (b) $\vec{E}$
(c) $\vec{E} \times \vec{B}$ (d) $\vec{B} \times \vec{E}$

CBSE-2023
Bihar Board-2019

Ans. (c) :

41. An electromagnetic wave is produced by a charge

(a) moving with a constant velocity
(b) moving with a constant speed parallel to a magnetic field
(c) moving with an acceleration
(d) at rest

CBSE-2023

Ans. (c) :

42. In a travelling plane electromagnetic wave, which of the following have zero average value?

(a) Magnetic energy and electric energy
(b) Magnetic field and electric field
(c) Magnetic energy and magnetic field
(d) Electric energy and electric field

CBSE-2020

Ans. (b) :

43. The oscillating electric and magnetic field vectors in an electromagnetic wave are

(a) perpendicular to each other and opposite in phase.
(b) parallel to each other and opposite in phase.
(c) perpendicular to each other and in the same phase.
(d) parallel to each other and in the same phase.

CBSE-2020

Ans. (c) :

44. Radio waves and visible light in vacuum have

(a) same velocity, same wavelength
(b) different velocity, different wavelength
(c) same wavelength, different velocity
(d) same velocity, different wavelength

Meghalaya Board-2013

Ans. (d) :

45. Speed of electromagnetic wave is same:

(a) for all wavelengths
(b) for all frequencies
(c) in all media
(d) for all intensitries.

Bihar Board-2021
J&K Board-2011
J&K Board-2011

Ans. (d) :

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46. Which of the following is an electromagnetic wave:

(a) Sound wave (b) Light wave
(c) Both of these (d) None of these

Uttarakhand Board-2019

Ans. (b) :

47. The direction of propagation of electromagnetic wave is-

(a) Parallel to $\vec{B}$ (b) Parallel to $\vec{E}$
(c) Parallel to $\vec{B}\times\vec{E}$ (d) Parallel to $\vec{E}\times\vec{B}$

Bihar Board-2019

Ans. (d) :

48. The phase difference between electric wave and magnetic wave in the electromagnetic wave is

(a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{3}$ (d) Zero

Bihar Board-2023

Ans. (d) :

Section-B (Very Short Answer)

49. Write four characteristics of electromagnetic waves.

Uttarakhand Board-2023

50. Electromagnetic waves are produced by accelerated charge. (True/False)

J&K Board-2019

51. Name any three electromagnetic waves.

Meghalaya Board-2015

52. …….. Waves are produced by hot bodies and molecules.

Haryana Board-2022

53. Write the name of electromagnetic wave produced by vacuum tube magnetron.

Rajasthan Board-2023

54. _____ was the first scientist who produced electromagnetic waves in a laboratory.

Punjab Board-2018

55. State the postulates of special theory of relativity.

Tamil Nadu Board-2017

56. Write any three uses of infrared radations.

Tamil Nadu Board-2017

57. The minimum wavelength of X-rays produced from a Coolidge tube is 0·05 nm. Find the operating voltage of the Coolidge tube.

Tamil Nadu Board-2011

58. What are the uses of X-rays?

Tamil Nadu Board-2023

OR

Write any three medical applications of X-rays.

Tamil Nadu Board-2017

59. Can an electromagnetic wave be deflected by magnetic or electric field? Explain.

J&K Board-2023

60. What does an electromagnetic wave consist of ? On what factors does its velocity in vacuum depend ?

J&K Board-2023

61. Why are electromagnetic waves called so ?

J&K Board-2023

62. Which part of electromagnetic spectrum has largest penetrating power?

J&K Board-2023

63. Show that the speed of propagation of an electromagnetic wave is equal to the speed of light.

Nagaland Board-2018

64. What are electromagnetic waves ? Write the equation for associated electric and magnetic fields.

Nagaland Board-2017

65. What are electromagnetic waves? Write any two properties of electromagnetic waves.

Nagaland Board-2021

66. Show that the speed of propagation of an electromagnetic wave is equal to the speed of light.

Nagaland Board-2020

67. The electric field in a plane electromagnetic wave is:

$E_x = 5.1 \cos(1.8 \times 10^{-2}y - 5.4 \times 10^{6}t)$ Newton/Coulomb. What is the wavelength and frequency of this wave?

Haryana Board-2018

68. The electric field in a plane electromagnetic wave is :

$Ex = 3.1 \cos(1.8 \times 10^{-2}\, y + 5.4 \times 10^{6}\, t)$

Newton/Coulomb. What is the wavelength and frequency of the wave?

Haryana Board-2018

69. What are electromagnetic waves? Write two uses of radio waves.

Haryana Board-2018

70. Summarise the photon picture of electromagnetic radiation, (any four)

Gujarat Board- March, 2020

71. A plane electromagnetic wave of frequency 25 MHz travels in free space along x-direction. At a particular point in space and time, $\vec{E} = 6.3\hat{j}\,Vm^{-1}$. What is $\vec{B}$ at this point?

Gujarat Board- March, 2020

72. Write the four Maxwell's equations in reference to electromagnetic waves.

Gujarat Board-2023

73. Name six types of electromagnetic waves in ascending order in terms of their wavelength.

Jharkhand Board-2020

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74. **Write any four characteristics of electromagnetic wave.**

CBSE-2022
Gujarat Board-March, 2022
J&K Board-2019, 2022
Odisha Board-2020, 2022
Bihar Board-2019
Meghalaya Board-2014

OR

Write any two main features of electromagnetic waves.

UP Board-2023

75. **Given two uses each of ultraviolet rays and microwaves.**

Jharkhand Board-2019

76. **What are electromagnetic waves? Write its _____.**

MP Board-2013

77. **Which waves are used as signal through fog and why?**

MP Board-2014

78. **Electromagnets are made of what materials?**

MP Board-2019

79. **Name the electromagnetic wave of 7800 Å to 10^7 Å wavelength range and write two important uses of it.**

Chhattisgarh Board-2021

80. **How infrared waves are produced? Write its two important uses.**

Chhattisgarh Board-2020

81. **The electric field amplitude of an electromagnetic wave in free space is 15 volt/metre. Calculate the amplitude of magnetic field.**

UP Board-2018

82. **Arrange the following waves in ascending order of their wavelengths:**
Radio waves, visible waves, ultraviolet waves, microwaves and X-rays.

UP Board-2021

83. **What are electromagnetic waves? By drawing its propagation diagram show the electric field and magnetic field components in it**

UP Board-2022

84. **Write any two main features of electromagnetic waves.**

UP Board-2023

85. **In an electromagnetic wave, how are electric vector (E), magnetic vector (B) and velocity of propagation of the wave (c) oriented ?**

ISC-2013

86. **State any one property which is common to all electromagnetic waves.**

ISC-2017

87. **How are electromagnetic waves produced by oscillating charges? What is the source of the energy associated with the em waves?**

CBSE-2019

88. **Write the range of the wavelength of the following electromagnetic radiations:**
(a) Infrared rays
(b) Ultraviolet rays
(c) γ-rayx
Write on use of each of the above.

CBSE-2019

89. **Illustrate by giving suitable examples, how you can show that electromagnetic waves carry both energy and momentum.**

CBSE-2019

90. **How are electromagnetic waves produced? Write their two characteristics.**

CBSE-2023
Chhattisgarh Board-2018

91. **Identify the electromagnetic wave whose wavelengths range is from about**
(a) 10^{-12} m to about 10^{-8} m.
(b) 10^{-3} m to about 10^{-1} m.
Write one use of each.

CBSE-2023

92. **Write any two characteristics of an electromagnetic wave. Why are microwaves used in radar systems ?**

CBSE-2023

93. **A plane electromagnetic wave propagates in vacuum along x-axis.**
(a) Give the direction of electric field and magnetic field vectors.
(b) E_0 and B_0 are the magnitudes of electric and magnetic fields respectively in a plane electromagnetic wave. Find the ratio of energy densities of electric field and magnetic field.

CBSE-2023

94. **(i) Draw a diagram showing a linearly polarized electromagnetic wave, propagating in the z-direction depicting $\vec{E}$ and $\vec{B}$.**
(ii) The wavelength of an electromagnetic wave is 10^{-10} m.
Identify the wave and mention its one use.

CBSE-2022

95. **Electromagnetic waves of wavelengths λ_1, λ_2 and λ_3 are used in radar systems, in water purifiers and in remote switches of TV, respectively.**
(i) Identify the electromagnetic waves, and
(ii) Write one source of each of them.

CBSE-2022

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96. Depict the fields diagram of an electromagnetic wave propagating along positive X-axis with its electric field along Y-axis.
CBSE-2020

97. In what ways are matter waves different from electromagnetic waves?
CBSE-2020

98. How does an oscillating charge radiate an electromagnetic wave ? Give the relation between the frequency of radiated wave and the frequency of oscillating charge.
CBSE-2020

99. (a) Explain briefly the fact that electromagnetic waves carry energy.
(b) Why do we not feel the pressure due to sunshine?
CBSE-2020

100. Name the electromagnetic radiations which may cause sunburn. Write their wavelength range.
CBSE-2020

101. Which physical quantity associated with an electromagnetic wave does not change when it propagates form one medium into another medium?
CBSE-2020

102. (i) Monochromatic light is incident on a surface separating two media. The frequency of the light after refraction remains unaffected but its wavelength changes why?
(ii) The frequency of an electromagnetic radiation is 1.0×10^{11} Hz. Identify the radiation and mention its two uses.
CBSE-2020

103. Identify the type of electromagnetic waves that can be produced in the process given below and give one application of each :
(a) Bombardment of high energy electrons on a heavy metal target
(b) Radioactive decay of the nucleus
CBSE-2020

104. Why are infrared radiations also referred to as heat waves ? Write the names of radiations which lie next to infrared radiations in the electromagnetic spectrum on
(a) shorter wavelength side, and
(b) longer wavelength side.
CBSE-2020

105. How does a charge 'q' oscillating at certain frequency produce electromagnetic waves?
Assam Board-2014

106. The most important predication to emerge from Maxwell's equations is
(i) eddy current
(ii) electromagnetic waves
(iii) displacement current
Assam Board-2023

107. In a plane electromagnetic wave, the electric field oscillates with a frequency of 6×10^8 Megahertz. In which region of the electromagnetic spectrum this wave is found?
Kerala Board-2017

108. Name the electromagnetic radiation which is used
(a) to kill concerous cells in human ;
(b) to produce dehydrated fruits.
Meghalaya Board-2019

109. The amplitude of the magnetic field of a harmonic electromagnetic wave in vacuum is B_o = 510 nT. What is the amplitude of the electric field part of the wave ?
Or
Electromagnetic waves travel in a medium with a speed of 2×10^8 m/s. The relative permeability of the medium is 1. Find the relative permittivity.
Meghalaya Board-2021

110. Write an expression for the speed of electromagnetic waves in free space.
Meghalaya Board-2017

111. The wavelength of an electromagnetic wave is 3×10^{-9} m. Which region of the electromagnetic spectrum does it belong to? Calculate its frequency.
Meghalaya Board-2023

112. How are electromagnetic waves produced?
Manipur Board-2022

113. Write the expression for speed of light interms of "μ_0" and "ϵ_0", explain the terms used.
Karnataka Board-March, 2019

114. What are electromagnetic waves? Write are expression for the velocity of electromagnetic waves in terms of permittivity and magnetic permeability of free space.
Karnataka Board-July, 2016

115. Find the wavelength of electromagnetic wave of frequency 5×10^{19} per second in free space.
Uttarakhand Board-2020

116. What is meant by 'Transverse nature of electromagnetic waves'?
Uttarakhand Board-2022

117. Explain the formation of stationary waves in stretched string and hence deduce the laws of transverse waves in stretched string.
AP Board-2023

118. Mention any three characteristics of electromagnetic waves.
Tamil Nadu Board-2015

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Section-C (Short Answer)

119. Give any six properties of e.m. waves. is

J&K Board-2018

OR

Write down important properties of electromagnetic waves,

J&K Board-2016

OR

What are electromagnetic waves. Write their characteristics (any six)

MP Board-2017

120. Write four differences between electromagnet and permanent magnet.

MP Board-2019

121. What are the Matter waves? How these wave differ from the mechanical wave and the electromagnetic waves?

An electron in hydrogen atom revolves in an orbit of radius 0.5 Å around the nucleus with speed 2.2×10^6 m/sec Calculate the equivalent electric current.

UP Board-2020

122. What are electromagnetic waves? Mention any three characteristics of electromagnetic waves. Find the frequency of electric field of the electromagnetic wave having wavelength of 5×10^{-6} m.

UP Board-2021

123. Name any two electromagnetic waves. State any one similarity and one difference between them.

ISC-2007, 2008

124. State how electric vector E, magnetic vector B and velocity vector c are oriented in an electromagnetic wave ?

ISC-2014, 2011

125. (a) Identify electromagnetic waves which :

(i) are used in radar system.

(ii) affect a photographic plate.

(iii) are used in surgery.

Write their frequency range.

CBSE-2022

126. Depict a plane electromagnetic wave propagating along the x-axis. Write the expressions for its oscillating electric and magnetic fields.

CBSE-2022

127. Name the electromagnetic waves which are produced by the following :

(i) Radioactive decays of nucleus

(ii) Welding arcs

(iii) Hot bodies

Write one use each of these waves.

CBSE-2022

128. (a) How are electro-magnetic waves produced ? Depict an electro-magnetic wave propagating in Z-direction with its magnetic field $\vec{B}$ oscillating along X-direction.

(b) Write two characteristics of electro-magnetic waves.

CBSE-2020

129. Name of electro-magnetic waves with their frequency range, produced in

(a) Some radioactive decay

(b) sparks during electric welding

(c) TV remote

CBSE-2020

130. Write the wavelength range and name of the electromagnetic waves which are used in (i) radar systems for aircraft navigation and (ii) Earth satellites to observe the growth of the crops.

CBSE-2020

131. Write the wavelength range and name of the electromagnetic waves which are used in (i) radar systems for aircraft navigation. and (ii) Earth satellites to observe the growth of the crops.

CBSE-2020

132. Write down the four Maxwell's equations.

OR

The electric field of an e.m. wave is given by

$$E_y = 40\sin\left(\frac{2\pi}{3}x - 2\pi\times10^8 t\right)$$

Where E is in V/m, t in seconds, and x is in meters.

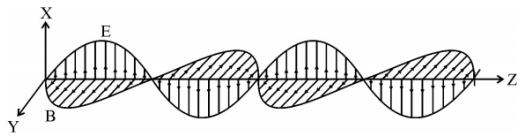
Find (i) Propagation vector K (ii) Wavelength λ and (iii) Frequency of the e.m. wave

Assam Board-2013

133. Discuss briefly the three modes of propagation of electromagnetic wave.

Assam Board-2017

134. A typical plane electromagnetic wave propagating along the Z direction is shown in figure.



(a) Write the equation for electric and magnetic fields.

(b) Write the methods of production of radio waves and microwaves. Write any one use of these waves.

Kerala Board-2020

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135. (a) The current due to time varying electric field is called..... .

(b) An electromagnetic wave travels in free space with a velocity of 3×10^8 m/s. At a particular point in space and time, magnitude of intensity of electric field is 6.3 V/m. What is magnitude of magnetic field at this point ?

Kerala Board-2021

136. Using supplied values of μ_0 and ε_0, find the speed of electromagnetic waves in vacuum.

Meghalaya Board-2013

137. What does an Electromagnetic wave convert of ? On what factors does its velocity in vacuum depend?

J&K Board-2021

138. Write any six characteristics of electromagnetic waves.

J&K Board-2020

139. Explain the formation of stationary waves in stretched strings and hence deduce the laws of transverse waves in stretched strings.

AP Board-2021

140. Explain the formation of a stationary waves in an air column enclosed in open pipe.

Derive the equations for the frequencies of the harmonics produced.

A pipe 30 cm long is open at both ends. Which harmonic mode of the pipe resonates 1100 Hz source. Velocity of sound is 330 m/s?

AP Board-2022

Section-D (Case-Based Questions)

141. Write down Maxwell equations in integral form.

Tamil Nadu Board-2023

142. Name the following electromagnetic waves and arrange them in decreasing order of their wavelength :

(a) Electromagnetic waves which are used for sterilizing surgical equipments

(b) Electromagnetic waves which are emitted from the nuclei of radioactive atoms

(c) Electromagnetic waves which are used by FM radio station for broadcasting

(d) Electromagnetic waves which are produced when fast moving electrons are stopped by a heavy metal target

Meghalaya Board-2015

Section-E (Long Answer)

143. How does the mutually supporting role of electric and magnetic fields result in the propagation of electromagnetic waves? Show the pictorial representation of a plane electromagnetic wave. State briefly the contribution of India physicist. Jagadish Chandra Bose in the field of electromagnetic waves.

NIOS-2014

144. The oscillating electric field of an electromagnetic wave is given by

$E_y = 30 \sin (2 \times 10^{11} t + 300 \pi x)$ volt / m

Find out –

i. wavelength of the electromagnetic wave

ii. amplitude of magnetic field

iii. equation of oscillating magnetic field.

UP Board-2019

III. Electromagnetic Spectrum

Section-A (Multiple Choice Questions)

145. What is the value of speed of X-rays in vacuum?

(a) 2 c (b) c

(c) $\frac{c}{2}$ (d) $\frac{c}{\sqrt{2}}$

Haryana Board-2018

Ans. (b) :

146. X-ray is :

(a) Conversion of energy into mass

(b) Phenomenon of conservation of kinetic energy into radiation

(c) Principle of conservation of charge

(d) Conversion of momentum

Tamil Nadu Board-2018

Tamil Nadu Board-March, 2016

Tamil Nadu Board-2011

Ans. (b) :

147. The electromagnetic waves used in the telecommunication in two lines are:

(a) ultraviolet (b) infrared

(c) visible (d) microwaves

J&K Board-2016, 2017

Ans. (d) :

148. Which of the following electromagnetic radiation has the smallest wavelength?

(a) X-rays (b) Radio waves

(c) Microwaves (d) UV-rays

Haryana Board-2018

Ans. (a) :

149. The wavelength of a wave having frequency 3×10^{13} Hz will be:

(a) 10^5 m (b) 3×10^5m

(c) 10^{-5} m (d) None

Haryana Board-2017

Ans. (c) :

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150. For which of the following stopping potential required is maximum?
(a) Red (b) Green
(c) Yellow (d) Blue
Haryana Board-2017

Ans. (c) :

151. The wavelength of a wave with frequency 10^{14} Hz will be:
(a) 3×10^{-6} m (b) 3×10^{6} m
(c) 10^{6} m (d) None
Haryana Board-2017

Ans. (a) :

152. Which of the following electromagnetic radiation has largest wavelength?
(a) X-rays (b) UV-rays
(c) Microwaves (d) Radio waves
Haryana Board-2016

Ans. (d) :

153. If photoelectric effect is not seen with the ultraviolet radiations in a given metal, photo electrons may be emitted with the___.
(a) radio waves (b) infrared waves
(c) X-rays (d) visible light
Gujarat Board- March, 2019

Ans. (c) :

154. For voice communication, cellular phones use which band of electromagnetic spectrum?
(a) LF (b) HF
(c) VHF (d) UHF
Gujarat Board- March, 2019

Ans. (d) :

155. ..... is used for photography is fog.
(a) Polaroid (b) Infrared
(c) Ulraviolet (d) X-rays
Jharkhand Board-2023

Ans. (b) :

156. If V_g, V_x and V_m are the speeds of gamma rays, X-rays and microwaves respectively in vacuum, then
(a) $V_g = V_x = V_m$ (b) $V_g > V_x > V_m$
(c) $V_g > V_x < V_m$ (d) $V_g < V_x < V_m$
Jharkhand Board-2019

Ans. (a) :

157. Infrared rays lie between:
(a) γ-rays and ultraviolet rays
(b) micro waves and visible light
(c) visible light and ultraviolet rays
(d) ultraviolet rays and X-rays
MP Board-2018

Ans. (b) :

158. Which one of the following electromagnetic radiations is most energetic?
(a) Ultraviolet radiations
(b) X-rays
(c) Infrared radiations
(d) Light rays
NIOS-2017

Ans. (b) :

159. Which one of the following electromagnetic radiation has the least wavelength?
(a) Gamma rays (b) Microwaves
(c) Visible light (d) X-rays
CBSE-2023

Ans. (a) :

160. Choose the correct option related to wavelengths (λ) of different parts of electromagnetic spectrum.
(a) $\lambda_{x\text{-rays}} < \lambda_{\text{micro waves}} < \lambda_{\text{radio waves}} < \lambda_{\text{visible}}$
(b) $\lambda_{\text{visible}} > \lambda_{x\text{-rays}} > \lambda_{\text{radio waves}} > \lambda_{\text{micro waves}}$
(c) $\lambda_{\text{radio wave}} > \lambda_{\text{micro waves}} > \lambda_{\text{visible}} > \lambda_{x\text{-rays}}$
(d) $\lambda_{\text{visible}} < \lambda_{\text{micro waves}} < \lambda_{\text{radio waves}} < \lambda_{x\text{-rays}}$
CBSE-2023
Meghalaya Board-2013

Ans. (c) :

161. The electromagnetic radiations used to kill germs in water purifiers are called :
(a) Infrared waves (b) X-rays
(c) Gamma rays (d) Ultraviolet rays
CBSE-2023

Ans. (d) :

162. A welder wears special glasses to protect his eyes mostly from the harmful effect of
(a) very intense visible light
(b) infrared radiation
(c) ultraviolet rays
(d) microwaves
CBSE-2020

Ans. (c) :

163. Electromagnetic waves used as a diagnostic tool in medicine are
(a) X-rays (b) ultraviolet rays
(c) infrared radiation (d) ultrasonic waves
CBSE-2020

Ans. (a) :

164. Velocity of light in free space is equal to
(a) $\sqrt{\varepsilon_o \mu_o}$ (b) ε_o / μ_o
(c) $\sqrt{\varepsilon_o / \mu_o}$ (d) $1/\sqrt{\varepsilon_o \mu_o}$
Goa Board-2019

Ans. (d) :

165. The range in which electromagnetic radiation of wavelength 3000 Å lies is
(a) visible (b) infrared
(c) ultraviolet (d) radio wave
Odisha Board-2020

Ans. (c) :

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166. Which of following will have maximum velocity in vacuum–
(a) Infrared waves
(b) Visible rays
(c) Ultraviolet rays
(d) All these will have same velocity
Uttarakhand Board-2020

Ans. (d) :

167. The solar spectrum is.
(a) Continuous
(b) Line spectrum
(c) Spectrum of black lines
(d) Spectrum of black bands
Bihar Board-2019

Ans. (a) :

168. Which one of the following electromagnetic radiations has minimum wavelength ?
(a) Ultraviolet (b) X-rays
(c) Microwaves (d) γ rays
Bihar Board-2023

Ans. (d) :

169. In visible spectrum, which colour has larger wavelength ?
(a) Red (b) Yellow
(c) Blue (d) Violet
Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

170. Write any four points for Infrared waves.
Gujarat Board- July, 2022

171. Write two uses of infrared rays.
Punjab Board-2018

OR

Give the uses of infrared rays.
J&K Board-2017

172. A Coolidge tube operates at 24, 8000 V. What is the maximum frequency of X-radiation emitted from Coolidge tube?
Tamil Nadu Board-September, 2016

173. State Moseley's law. Write its equation.
Tamil Nadu Board-March, 2016

174. Write any three uses of ultraviolet radiation.
Tamil Nadu Board-2016

175. Give the wavelength and frequency of (i) Radio waves. (ii) Infrared waves.
J&K Board-2015,2014

176. Which part of electromagnetic spectrum has largest penetrating power?
J&K Board-2023

177. Microwaves are used in radar. Why ?
Nagaland Board-2017

178. Write two uses each of radio waves and X-rays.
Haryana Board-2017

179. Write two uses of microwaves and radiowaves.
Haryana Board-2017

180. Write two uses of UV-rays and X-rays.
Haryana Board-2017

181. What are electromagnetic waves? Write two uses of microwaves.
Haryana Board-2016

182. Write any four points for photon picture of electromagnetic radiation.
Gujarat Board-March, 2022

183. Write the name of the radiations of shortest and longest wavelength in the electromagnetic spectrum.
MP Board-2015

184. Write two uses of gamma rays.
MP Board-2018

185. What are X-rays? Write two uses X-rays
MP Board-2019

186. Arrange the different waves present in the electromagnetic spectrum in the order of their increasing wavelengths.
MP Board-2019

187. Write the wavelength range of visible light.
MP Board-2019

188. Red light is generally used in the dark room of photography. Why?
MP Board-2021

189. Write two uses of Gamma rays.
MP Board-2021

190. Microwaves, X-rays, UV-rays, infrared rays. Which of the above electromagnetic waves has
(i) the shortest wavelength?
(ii) the lowest frequency?
ISC-2005

191. How long would gamma radiation take to travel from the sun to the Earth, a distance of 1.5×10^{11}m ?
ISC-2013

192. Name the part of the electromagnetic spectrum which is
(i) suitable for radar systems used in aircraft navigation
(ii) produced by bombarding a metal target with high speed electrons
ISC-2014

193. Arrange the following electromagnetic waves in increasing order of their frequencies (i.e. begin with the lowest frequency):
Visible light, γ-rays, X-rays, microwaves, radio waves, infrared radiations and ultraviolet radiations.
ISC-2017

194. To which regions of the electromagnetic spectrum do the following wavelength belong :
(a) 250 nm (b) 1500 nm
ISC-2016

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195. Which electromagnetic radiation has wavelength greater than that of X-rays and smaller than that of visible light ?

ISC-2012, 2010

196. In which part of electromagnetic spectrum, do the following radiation lie

(i) having wavelength of 20 nm

(ii) having frequency of 10 MHz

ISC-2009

197. Which part of the electromagnetic spectrum is used in RADAR? Give its frequency range.

OR

How are electromagnetic waves produced by accelerating charges ?

CBSE-2019

198. How are infrared waves produced ? Why are these waves referred to as heat waves? Give any two uses of infrared waves.

OR

How are X-rays produced? Give any two uses of these.

CBSE-2023

199. Identify the part of electromagnetic spectrum which is :

(a) next to the lowest frequency end of the visible part of electromagnetic spectrum, and

(b) produced by bombarding a metal target by high energy electrons. Give one use of each of them.

CBSE-2023

200. (i) Arrange the following electromagnetic radiation in the ascending order of their frequencies :

X-rays, microwaves, gamma rays, radio waves

(ii) Write two uses of any two of these radiation

CBSE-2022

201. Which of the following electromagnetic waves has (a) minimum wavelength, and (b) minimum frequency ? Write one use of each of these two waves.

Infrared waves, Microwaves, γ-rays and X-rays.

CBSE-2020

202. Why are infrared waves called heat waves?

Assam Board-2014

203. Mention the relative positions of X-Rays and γ-Rays in the EM wave spectrum and give examples of their usage.

Assam Board-2017

204. Why infrared waves are called heat waves?

Assam Board-2016

205. How does a microwave oven work?

Assam Board-2016

206. What is the range of wavelength of electromagnetic radiation that nature has endowed our retina to detect?

Assam Board-2016

207. Match the following:

A	B	C
Radio waves	Nuclear reactions	Destroy cancer cells
Ultraviolet rays	Inner shell electron transition	Detect fake currency notes
	Acceleration of charges in conducting wires	Physical therapy
		Cellular phones

Kerala Board-2016

208. Name the part of the electromagnetic spectrum whose wavelength lies in the range 10^{-10}m. Give its one use.

Meghalaya Board-2021

209. State two applications each of X-rays and radio waves.

Meghalaya Board-2018

210. Write the following radiations in the ascending order of their wavelengths:

Microwaves, Ultraviolet rays, Gamma rays, Infrared rays.

Meghalaya Board-2018

211. Give one use of each of the following :

(a) Infrared rays

(b) Gamma rays

(c) Microwaves

(d) ultraviolet radiations

Meghalaya Board-2017

212. Explain energy distribution spectrum of a black body radiation in terms of wavelength.

Maharashtra Board-2020

213. Give the uses of X-rays.

J&K Board-2011

214. Give two points of difference between alpha and beta particles.

Manipur Board-2022

215. Why does microwave oven heats up a food item containing water molecules most efficiently?

Manipur Board-2022

216. Why does sky appear blue?

Karnataka Board-March, 2020

217. Arrange the following electromagnetic waves in ascending order of their wavelength : Radio waves, Gamma rays, Infrared waves, X-rays

Karnataka Board-March, 2020

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218. Name the spectral series of hydrogen which lies in the ultraviolet region of electromagnetic spectrum.

Karnataka Board-March, 2015

219. Give any two applications of X –rays.

Karnataka Board-July, 2018

220. Given the wavelength range of X-rays.

Karnataka Board-March, 2016

221. Give any two applications of ultraviolet radiations.

Karnataka Board-July, 2018, 2019

222. Give any two uses of microwaves.

Telangana Board-2018
Karnataka Board-March, 2017
Karnataka Board-July, 2014

223. Give the wavelength range of electromagnetic spectrum.

Karnataka Board-July, 2020

224. Who predicted the existence of electromagnetic waves? Give the wavelength range of electromagnetic spectrum.

Karnataka Board-March, 2014

225. Name the two electromagnetic waves used in human medication. Which one of these two has more frequency?

Uttarakhand Board-2019

226. Give two uses of infrared rays.

AP Board-2023
Karnataka Board-July, 2020
Karnataka Board-March, 2015

227. What are microwaves ?

Bihar Board-2022

Section-C (Short Answer)

228. What is characteristic X-ray spectrum? Explain its origin.

Tamil Nadu Board-2011

229. Write four main properties of γ-rays. Whose wavelength is larger among γ-rays and ultraviolet rays?

UP Board-2023

230. Arrange all the seven types of electromagnetic radiations in increasing order of their frequencies. You must begin with a radiation with lowest frequency and end with the one having the highest frequency.

ISC-2014, 2011

231. Name the radiation of the electromagnetic spectrum which is used for the following :
(a) Radar
(b) To photograph internal parts of human body
(c) For taking photographs of the sky during night and foggy conditions. Give the frequency range in each case.

CBSE-2019

232. Identify the part of the electromagnetic spectrum used in (i) radar and (ii) eye surgery. Write their frequency range.

CBSE-2019

233. What is radiation pressure?

Assam Board-2015

234. Electromagnetic spectrum is an orderly arrangement of electromagnetic radiations in the ascending or descending order of frequency/wavelength.

(a) Arrange the following electromagnetic radiations in the ascending order of frequency.
Visible rays, Infrared rays, X-rays, microwaves.
(b) Given one application of infrared and X-rays each.

Kerala Board-2013

235. State one use of each and identify which one of them has higher frequency and which one has higher wavelength.
(i) X-rays
(ii) Microwaves

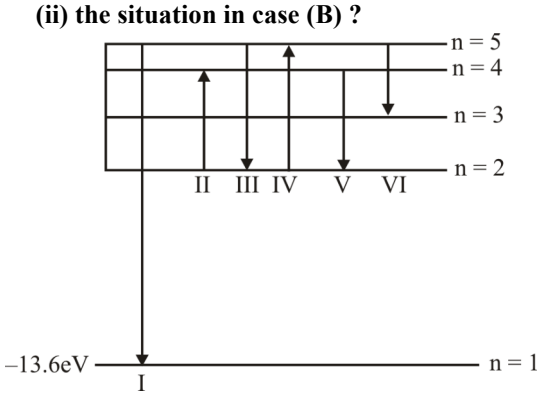
Goa Board-2023

Section-D (Long Answer)

236. Describe very briefly and four regions of electromagnetic spectrum mentioning their special properties/features.

ISC-2002

237. Case (A) : A source emits photons of certain frequencies which are analysed to get a spectrum in the visible region.
Case (B) : Photons with continuous range of frequencies are passed through a rarefied gas and then analyzed to get a spectrum in the visible region.
What is the difference between the two spectra obtained?
Form the given figure. Which transitions may describe:
(i) the situation in case (A) ?
(ii) the situation in case (B) ?



Goa Board-2023

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09. Ray Optics and Instruments

I. Reflection of Light Through Plain Mirror

Section-A (Multiple Choice Questions)

1. Power of plane mirror is _____.
(a) +1 (b) ∞
(c) 0 (d) –1
Gujarat Board-2023

Ans. (c) :

2. A person standing in front of a mirror, finds his image larger than himself. This implies that the mirror is:
(a) Convex (b) Parabolic
(c) Plane (d) Concave
J&K Board-2018

Ans. (d) :

3. For plane mirror, value of magnification m=1, then its focal length *f* =____.
(a) zero (b) positive
(c) negative (d) infinite
Gujarat Board- March, 2019

Ans. (d) :

Section-B (Very Short Answer)

4. Write two advantages of total reflecting prisms over a plane mirror.
Manipur Board-2022

5. Which mirror has an infinite focal length?
Chhattisgarh Board-2020

6. A plane mirror lies on x-y plane. If the incident ray is on y-z plane then the reflected ray and the normal will lie on
(i) x -y and y-z plane
(ii) y-z and z-x plane
(iii) z-x and x-y plane
Assam Board-2023

II. Reflection of Light Through Spherical Mirror and Mirror Formula

Section-A (Multiple Choice Questions)

7. Which of the following represents correct mirror formula?
(a) $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$ (b) $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$
(c) $f=v+u$ (d) $\frac{1}{f}=v+u$
Haryana Board-2016, 2018

Ans. (b) :

8. An object is placed at 10 cm in front of a concave mirror of radius of curvature 15 cm. Then magnification of image is____.
(a) $-\frac{1}{3}$ (b) –3
(c) 3 (d) $\frac{1}{3}$
Gujarat Board- August, 2020

Ans. (b) :

9. Optical phenomenon taking place for mirror and lens respectively are ___ & ___.
(a) reflection, diffraction
(b) interference, diffraction
(c) reflection, refraction
(d) refraction interference
Gujarat Board-2023

Ans. (c) :

10. When light rays undergoes _____ internal reflections inside a raindrop a secondary rainbow is formed.
(a) 3 (b) 2
(c) 1 (d) 4
Gujarat Board-March, 2022

Ans. (b) :

11. An object is placed at 15cm in front of a concave mirror of radius of curvature 20cm. The image distance would be _____cm.
(a) –30 (b) –28
(c) –22 (d) –32
Gujarat Board-March, 2022

Ans. (a) :

12. An object pin is kept on an axis of a concave mirror between pole (P) and focal point (F). Its image would be
(a) Real, Inverted and Small
(b) Real, Errect and Big
(c) Virtual, Inverted and Small
(d) Virtual, Errect and Big
Gujarat Board- July, 2022

Ans. (d) :

13. A virtual image larger than the object is formed in
(a) Convex mirror (b) Concave mirror
(c) Plane mirror (d) None of these
Jharkhand Board-2023

Ans. (b) :

14. When a light wave travels from air to glass
(a) its wavelength decreases.
(b) its wavelength increases.
(c) there is no change in wavelength.
(d) its frequency decreases.
ISC-2017

Ans. (a) :

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15. A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5×10^8 ms^{-1} and 230 nm respectively. The wavelength of light in air will be

(a) 230 nm (b) 345 nm
(c) 460 nm (d) 690 nm

CBSE-2023

Ans. (c) :

16. The coefficient of reflection for total internal reflection will be

(a) 0.5 (b) 1
(c) 0 (d) ∞

Bihar Board-2023

Ans. (b) :

17. A spherical mirror is immersed in water. Its focal length will

(a) decrease (b) increase
(c) remain same (d) none of these

Bihar Board-2023

Ans. (c) :

Section-B (Very Short Answer)

18. State laws of refraction.

Uttarakhand Board-2022
Karnataka Board-July, 2014

19. State Snell's law of refraction of light.

Assam Board-2014

20. Draw the ray diagram to show the location of the principal focus of a convex mirror. Identify the pole and Centre of Curvature.

Assam Board-2017

21. Write the mirror equation. Define magnification and find the expression for magnification m from the mirror equation.

Assam Board-2023

22. A concave mirror of focal length 12 cm produces three times enlarged image for two different positions of the object.

(a) Draw the ray diagram for the two cases.
(b) Calculate the distance between these positions of the object.

CBSE-2020

23. State the laws of reflection.

Meghalaya Board-2015

24. The radius of curvature of a concave mirror is 28 cm, its focal length will be ?

Rajasthan Board-2023

25. If the focal length of a concave mirror is f and radius of curvature is R, then prove that radius of curvature is twice the focal length.

Rajasthan Board-2022

26. A 2.0 cm object is placed at 15 cm in front of a concave mirror of focal length 10 cm. Find the position, size and nature of the image.

Nagaland Board-2017

29. Write any two differences between regular and irregular (diffused) reflection

MP Board-2014

27. What is reflection? Write the laws of reflection.

MP Board-2015, 2018

28. Derive the relation between f and R for a spherical mirror.

Tamil Nadu Board-2022
MP Board-2013, 2015

29. Define focal length for a mirror and calculate focal length of a mirror having radius of curvature 20cm.

Haryana Board-2016

30. An object lies on the principal axis of a concave mirror with radius of curvature 160 cm. Its image appear erect at a distance 70 cm from it. Determine the position of the object. 1

Gujarat Board- May, 2021

31. At what distance in front of a concave mirror of focal length 10 cm, an object be placed so that its real image of size five times that of the object obtain?

MP Board-2013

32. Draw a ray diagram for the image formed by a concave mirror when the object is placed between pole and focus and write the conclusion.

MP Board-2018

33. An object is placed at 10 cm distance infornt of a concave mirror of radius of curvature 20 cm. Find the position, nature and magnification of the image.

MP Board-2019

34. Draw a ray diagram to show the path of a ray of light which is incident normally on a concave mirror and is reflected.

NIOS-2012

35. A concave mirror of large aperture does not produce a sharp point image of a point object. Name this defect of spherical mirrors.

NIOS-2014

36. An object of length 6 cm is placed on the axis of a concave mirror of focal length f, at distance $2f$ from the pole and normal to the axis. What is the length of the image and where is it formed ?

UP Board-2017

37. In the case of a concave mirror of focal length f, when an object is kept between f and 2f, show that its image is formed beyond 2f.

CBSE-2019

38. Show that the image formed by a convex mirror of an object is always virtual.

CBSE-2019

39. An object is kept in front of a concave mirror of focal length 15 cm. The image formed is real and three times the size of the object. Calculate the distance of the object from the mirror.

CBSE-2019

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40. For paraxial rays, show that the focal length of a spherical mirror is one-half of its radius of curvature.

CBSE-2019

41. An object is placed in front of a concave mirror of focal length of 12 cm.
There are two possible positions of the object for which the image formed is three times the size of the object.
(a) Draw the ray diagram for the each case, and
(b) Find the distance between the two positions of the object.

CBSE-2020

42. An object is placed in front of a convex mirror of focal length 15 cm. It produces an image that is half the size of the object. Find (a) position of the object, (b) nature of the image, and (c) draw the ray diagram of image formation.

CBSE-2020

43. An object is kept 20 cm in front of a concave mirror of radius of curvature 60 cm. Find the nature and position of the image formed.

CBSE-2020

44. Draw a ray diagram to show formation of virtual image by a concave mirror.

Assam Board-2013

45. A square loop of side 3cm is placed 25cm away from a concave mirror of focal length 10cm. The axis of the mirror passes through the intersecting point of the diagonals of the loop and is perpendicular to the plane of the loop. What is the area enclosed by the image of the loop?

Assam Board-2017

Section-C (Short Answer)

46. Explain the term critical angle for a pair of media. Derive a relation between critical angle and refractive index of a denser medium with respect to a rarer medium.

Meghalaya Board-2015

47. Draw a ray diagram for image formation by concave mirror and establish a relation between object distance (u), image distance (v) and focal length (f)

Rajasthan Board-2023

48. A concave mirror produces a two times enlarged virtual image of an object placed 15 cm away from the mirror.
(a) Find the focal length of the mirror.
(b) By how much distance should the object be displaced and in what direction, in order to get two times enlarged real image of the object?

CBSE-2020

49. Deduce the relation between object and image distance in terms of refractive index of the medium and the radius of curvature of curved spherical surface.

Nagaland Board-2020

50. A 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15cm. Given the location of image and determine the magnification.

Jharkhand Board-2019

51. Derive following expression for the refraction at a spherical surface $\frac{\mu}{v}-\frac{1}{u}=\frac{\mu-1}{R}$.

Jharkhand Board-2023
UP Board-2017
MP Board-2012, 2020

52. Deduce following relationship between focal length f of a concave mirror : $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$
Where the symbols have their usual meaning.

MP Board-2020
CBSE-2020

53. What is optical fiber? Write its uses (any four).

Meghalaya Board-2023
Chhattisgarh Board-2022
MP Board-2015

54. A candle is placed at 12 cm distance from a concave mirror. Radius of curvature of the mirror is 10 cm. Find the position, nature and magnification of the image.

Chhattisgarh Board-2019

55. (a) (i) Draw a ray diagram showing the formation of a real image of an object placed at a distance 'u' in front of a concave mirror of radius of curvature 'R'. Hence, obtain the relation for the image distance 'v' in terms of u and R.
(ii) A 1·8 m tall person stands in front of a convex lens of focal length 1 m, at a distance of 5 m. Find the position and height of the image formed.

CBSE-2023

56. A concave mirror of focal length 12 cm forms a three times magnified virtual image of an object. Find the distance of the object from the mirror.

CBSE-2023

57. Consider a convex spherical surface of radius of curvature R, separating two media of refractive indices n_1 and n_2 (> n_1). A point object is placed at a distance u in front of the surface in medium of refractive index n_1. Its real image is formed at a distance v. Obtain a relation between u and v in terms of n_1, n_2 and R.

CBSE-2022

58. A concave mirror forms real image of an object kept at a distance 9 cm from it. If the object is taken away from the mirror by 6 cm, the image

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size reduce to $\frac{1}{4}^{th}$ of its previous size. Find the focal length of the mirror.

CBSE-2020

59. Two objects P and Q when placed at different positions in front of a concave mirror of focal length 20 cm, form real images of equal size. Size of object P is three times size of object Q. If the distance of P is 50 cm from the mirror, find the distance of Q from the mirror.

CBSE-2020

60. (a) Using the necessary ray diagram, derive the mirror formula concave mirror.
(b) In the magnified image of a measuring scale (with equidistant markings) lying along the principal axis of concave mirror, the markings are not equidistant, Explain.

CBSE-2020

61. A concave mirror produces a two times enlarged virtual image of an object placed 10 cm away from the mirror.
(a) Find the focal length of the mirror.
(b) By how much distance should the object be displaced and in what direction, in order to get two times enlarged real image of the object?

CBSE-2020

Section-D (Long Answer)

62. Light has several properties like reflection, refraction etc. When light travels from an optically denser medium to a rarer medium?
(a) What happens to the light at the interface?
(b) Give a demonstration for total internal reflection.
(c) What are the technological applications of total internal reflection in nature? Briefly explain it.

Kerala Board-2014

63. With the help of a ray diagram, show the formation of image of a point object by refraction of light at a spherical convex surface separating two media of refraction indices μ_1 and μ_2 ($\mu_2 > \mu_1$) respectively. Using this diagram derive the relation

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

where used symbols have their usual meanings.

[1+4=5]

Chhattisgarh Board-2019

64. Draw a ray diagram to show the image formation by a concave mirror when the object is kept beyond its focus. Using this diagram, derive the mirror equation.

Manipur Board-2022

65. Derive the mirror equation and the equation for lateral magnification.

Tamil Nadu Board-2023

66. Use the mirror equation to deduce that.
(a) An object placed between f and 2f of a concave mirror produces a real image beyond 2f.
(b) The virtual image produced by a convex mirror is always diminished in size and is located between the focus and the pole.

Gujarat Board- August, 2020

67. What are conjugate foci? Deduce the following relationship between the focal length f of a spherical mirror, distance of object u and distance of image v:

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

MP Board-2013

68. Establish the relation $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \left(\frac{\mu_2 - u_1}{R}\right)$ For refraction at a convex spherical surface of absolute refractive index μ_2 placed in a rarer medium of absolute refractive index μ_1, where u and v denote the object and the image (real) distance from the pole of the convex spherical surface.

Meghalaya Board-2013

69. With the help of a diagram, obtain a relation between object distance, image distance and focal length of a concave mirror.
If the concave mirror is immersed in water, will the above equation be still valid?

Goa Board-2023

70. The refractive indices of water and diamond are $\frac{4}{3}$ and 2.42 respectively. Find the speed of light in water and diamond.
($c = 3\times10^8$ m/s)

Maharashtra Board-2018

71. Establish the relation among object distance (u), image distance (v) and focal length (f) for a concave mirror. Discuss how the size and nature of image vary with the position of image.

Odisha Board-2023

72. Draw a ray diagram showing the formation of the image by point object on the principal axis of a spherical convex surface separating two media of refractive indices n_1 and n_2 when a point source is kept in rarer medium of refractive index n_1. Derive the relation between object and image distance in terms of refractive indices of the media and radius of curvature of the surface.

Manipur Board-2022

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III. Refraction Through Glass, Refractive Index

Section-A (Multiple Choice Questions)

73. The phenomenon of light responsible for formation of mirage is
(a) refraction (b) interference
(c)total internal reflection (d) polarization
Odisha Board-2023

Ans. (c) :

74. Total internal reflection may be observed if
(a) light ray is travelling from denser medium to rarer medium
(b) light ray is travelling from rarer medium to denser medium
(c) Light ray is travelling from any medium to another medium
Kerala Board-2020

Ans. (a) :

75. Mirage is formed due to which of the following?
(a) Total internal reflection
(b) Refraction
(c) Reflection
(d) Diffraction
Haryana Board-2018

Ans. (a) :

76. The working of an optical fibre depends upon:
(a) Reflection
(b) Moment
(c) Refraction
(d) Total internal reflection
Bihar Board-2021
Kerala Board-2020
Haryana Board-2017

Ans. (d) :

77. A ray of light travelling in air is incident on a denser surface at an angle of 60º. If the velocity of light in the denser medium is 2×10^8 ms $^{-1}$, the angle of refraction inside the denser medium is:
(a) 30º (b) $\sin^{-1}(0.75)$
(c) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (d) $\sin^{-1}(0.6666)$
Tamil Nadu Board-March, 2016

Ans. (c) :

78. The refractive index of the medium for the polarising angle 60° is :
(a) 1.732 (b) 1.414
(c) 1.5 (d) 1.468
Tamil Nadu Board-2016, 2017

Ans. (a) :

79. A ray of light is incident normally on a glass surface of refractive index 1.5. The angle of refraction is :
(a) 30° (b) Sin^{-1} (0.666)
(c) zero (d) $\sin^{-1}(0.75)$
Tamil Nadu Board-2016

Ans. (c) :

80. An air bubble in glass slab of refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness of the slab is :
(a) 12 cm (b) 8 cm
(c) 16 cm (d) 10 cm
Tamil Nadu Board-2022

Ans. (a) :

81. If refractive index of denser medium 1 with respect to rarer medium 2 is n_{12} an critical angle for this pair of media is i_c , then correct relation between n_{12} and i_c is
(a) $n_{12} = \sin i_c$ (b) $n_{12} = \tan i_c$
(c) $n_{12} = \frac{1}{\tan i_c}$ (d) $n_{12} = \frac{1}{\sin i_c}$
Rajasthan Board-2022

Ans. (d) :

82. Speed of light in air is 3×10^8 m/s. For the glass of refractive index 1.5 the speed of light in glass will be:
(a) 1.5×10^8 m/s (b) 2×10^8 m/s
(c) 1×10^8 m/s (d) 2.5×10^8 m/s
Haryana Board-2022

Ans. (b) :

83. The refractive index of water is 4/3. What is the speed of light in water?
(a) $3\times10^8 ms^{-1}$ (b) $2.25\times10^8 ms^{-1}$
(c) $4\times10^8 ms^{-1}$ (d) $2\times10^8 ms^{-1}$
Gujarat Board- August, 2020

Ans. (b) :

84. Depth of a completely filled well is 11m and refractive index of water is 1.33. If viewed normally from top, by how much height would the bottom of the well appear to be shifted up?
(a) 2.73m (b) 11m
(c) 4.13m (d) 1.37m
Gujarat Board- March, 2019

Ans. (a) :

85. Which of the following is responsible for glittering of a diamond?
(a) Diffraction
(b) Interference
(c) Total internal reflection
(d) Refraction
Gujarat Board- March, 2019

Ans. (c) :

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86. The refractive index of a medium is $\frac{3}{2}$. The speed of light in this medium is ____m/s [Speed of light in vacuum is c = 3 ×10^8 m/s]

(a) 2×10^8 (b) 2.5×10^8
(c) 3×10^8 (d) 3.5×10^8

Gujarat Board-2023

Ans. (a) :

87. Unpolarised light is incident on a plane glass surface. For an angle of incidence _____the reflected and refracted rays are perpendicular to each other? Refractive index of glass = 1.5

(a) 57° (b) 47°
(c) 37° (d) 67°

Gujarat Board-March, 2022

Ans. (a) :

88. The refractive index of medium-3 with respect to medium-2 n_{32} = _____.

(a) $\frac{n_{12}}{n_{31}}$ (b) $\frac{n_{31}}{n_{12}}$
(c) $n_{31}\times n_{12}$ (d) $n_{13}\times n_{21}$

Gujarat Board-March, 2022

Ans. (b) :

89. A magician during a show makes a glass lens with refractive index n = 1.5 disappear in a trough of liquid. The refractive index of liquid = _____.

(a) 0.75 (b) 3.0
(c) 1.5 (d) 0.15

Gujarat Board-March, 2022

Ans. (c) :

90. A ray of light is incident on a glass plate at an angle of 60°, If the reflected and refracted rays are mutually perpendicular, then the refractive index of the material is

(a) $\frac{\sqrt{3}}{2}$ (b) $\sqrt{3}$
(c) $\frac{1}{\sqrt{3}}$ (d) $\frac{1}{2}$

Jharkhand Board-2023

Ans. (b) :

91. A ray of light travels a distance of 12.0 m in a transparent sheet in 60 ns. The refractive index of the sheet is

(a) 1.33 (b) 1.50
(c) 1.65 (d) 1.75

CBSE-2023

Ans. (b) :

92. Which of the following pairs of media has the least value of critical angle ?

(a) Glass to air (b) Glass to water
(c) Diamond to water (d) Diamond to air

CBSE-2023

Ans. (d) :

93. A beam of light passing from air into a transparent medium, suffers a deviation of 15° at the interface, when incident at an angle of 60° the speed of light in the medium is .

(a) $\sqrt{3}\times10^8 m/s$ (b) $\sqrt{6}\times10^8 m/s$
(c) $\sqrt{2}\times10^8 m/s$ (d) $\sqrt{5}\times10^8 m/s$

Goa Board-2018

Ans. (b) :

94. A substance has critical angle of 45° for yellow light, its refractive index is-

(a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{2}$
(c) 1 (d) 1.5

Manipur Board-2022

Ans. (b) :

95. Which one of the following has maximum refractive index?

(a) glass (b) water
(c) iron (d) diamond

Bihar Board-2019, 2022

Ans. (d) :

96. Dispersive power is

(a) $\omega=\frac{\mu_v-\mu_r}{\mu_y-1}$ (b) $\omega=\frac{\mu_r-\mu_v}{\mu_y-1}$
(c) $\omega=\frac{\mu_v+\mu_r}{\mu_y-1}$ (d) $\omega=\frac{\mu_r+\mu_b}{\mu_y-1}$

Bihar Board-2021

Ans. (c) :

97. Absolute refractive index of ice is

(a) 1.21 (b) 1.31
(c) 1.41 (d) 1.51

Bihar Board-2021

Ans. (b) :

98. The refractive index of a medium is $\sqrt{2}$. Its corresponding critical angle will be

(a) 30° (b) 45°
(c) 60° (d) 90°

Bihar Board-2021

Ans. (b) :

99. A ray of light travels from glass $\left(\text{refractive index}=\frac{3}{2}\right)$ into water $\left(\text{refractive index}=\frac{4}{3}\right)$. The value of critical angle will be

(a) $\sin^{-1}\left(\frac{1}{2}\right)$ (b) $\sin^{-1}\left(\sqrt{8/9}\right)$
(c) $\sin^{-1}\left(\frac{8}{9}\right)$ (d) $\sin^{-1}\left(\frac{5}{7}\right)$

Bihar Board-2022

Ans. (c) :

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Section-B (Very Short Answer)

100 **Mirage is an optical phenomenon related to**
(i) scattering
(ii) total internal reflection
(iii) total internal refraction

Assam Board-2023

101. **A plane wavefront is travelling from lighter medium 1 to denser medium 2 through the interface of mediums 1 and 2 with velocities v_1 and v_2 and you know well that sin i/sinr = v_1/v_2, where i and r are the angles of incidence and refraction. If n_1 and n_2 be the refractive indices of the mediums then derive Snell's law.**

Assam Board-2023

102. **Explain the formation of mirage with example.**

AP Board-2023

103. **Explain the formation of mirage**

AP Board-2022

104. **What is total reflection ? Mention two conditions for total internal reflection.**

CBSE-2022
Karnataka Board-July, 2020

105. **If its stopping potential is 0.60 V, find the wavelength of the incident radiation.**

Assam Board-2014

106. **A photo electric surface has work function 2eV. What is the maximum velocity of the photoelectrons ejected by light of wavelength $3000\,\mathring{A}$.**

Assam Board-2016

107. **Draw the schematic diagram of experimental arrangement used by Davisson and Germer to observe electron diffraction.**

Assam Board-2016

108. **Generally Mirage is observed in deserts. Give reason for this.**

Uttarakhand Board-2020

109. **What is total internal reflection? Mention two applications of optical fibres.**

Odisha-2020
Karnataka Board-July, 2016
Meghalaya Board-2014

110. **A tank is filled with a transparent liquid to height 'H' A coin suspended by a thread in the liquid is gradually lowered till it touches the bottom. The apparent depth is determined corresponding to different positions of the coin.**
(i) Plot a graph showing variation of the apparent depth with the real depth of the coin.
(ii) What is the physical significance of the slope of the graph?

CBSE-2022

111. **(a) Is the speed of light in glass independent of the colour of light ? Give reason.**
(b) A small bulb is placed at the bottom of a tank containing water to a depth of 70 cm. Find the area of the surface of water through which light from the bulb can emerge out. Given refractive index of water is $\frac{4}{3}$

CBSE-2022

112. **A diver looking up through water $\left(\mu = \frac{4}{3}\right)$ sees the outside world contained in a circular area on the surface of water. If the diver's eyes are $\sqrt{7}$ m below the surface of water, then calculate the area of the circle.**

CBSE-2022

113. **Define critical angle. What are the conditions for total internal reflection?**

Jharkhand Board-2018

114. **What are the conditions for total internal reflection ? Write any one of its practical applications.**

Bihar Board-2022

115. **Is the speed of light in glass independent of the colour of light ? (Yes or No)**

Haryana Board-2022

116. **The …… angle for a ray incident from a denser to rarer medium, is that angle for which the angle of refraction is 90°.**

Haryana Board-2022

117. **The refractive index of the medium is $\sqrt{3}$. Calculate the angle of refraction if the unpolarised light is incident on it at the polarising angle of the medium.**

Tamil Nadu Board-2016

118. **The angle of minimum deviation for the equilateral prism is 40°. Find the refractive index of the material of the prism.**

Tamil Nadu Board-2022

119. **Draw a graph between angle of incidence (i) and angle of deviation (δ) for a triangular prism.**

Rajasthan Board-2022

120. **Establish the relation between critical angle and refractive index of medium.**

MP Board-2017

121. **With the help of a self-explanatory labelled ray diagram, establish a relation between the polarising angle and the refractive index of any transparent material when an unpolarised light is reflected by it.**

NIOS-2014

122. **In the figure, the path of parallel beam of light, passing through a convex lens of refractive index n_2, kept in a medium of refractive index n_1 is shown. How are n_1 and n_2 related to each other?**

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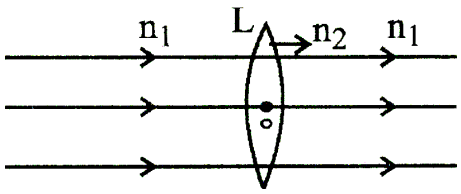


NIOS-2016

123. What will be the effect on focal length and nature of convex lens of glass of refractive index $n = \frac{3}{2}$ dipped in a liquid of refractive index $n = \frac{3}{2}$?

UP Board-2023

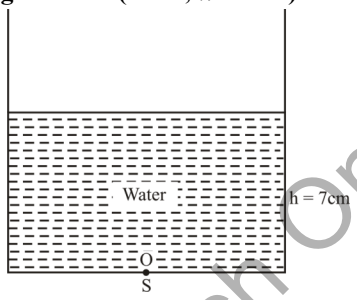
124. Find critical angle for glass and water pair, given refractive index of glass is 1.62 and that of water is 1.33.

ISC-2016

125. A point source of monochromatic light S is kept at the centre C of the bottom of a cylinder. The radius of the circular base of the cylinder is 15.0 cm.

The cylinder contains water (refractive index $= \frac{4}{3}$) to a height of 7.0 cm as shown in the figure.

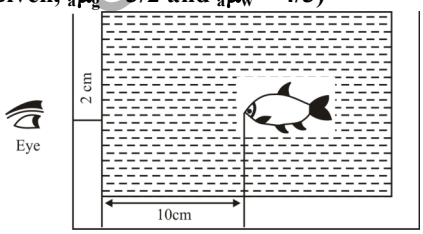
Find the area surface through which light emerges in air. (Take, $\pi = 22/7$)



ISC-2009

126. A fish is located at a distance of 10 cm from the wall of fish pond. The thickness of the glass wall is 2 cm. Find the apparent position of the fish

(Given, ${}_a\mu_g = 3/2$ and ${}_a\mu_w = 4/3$)

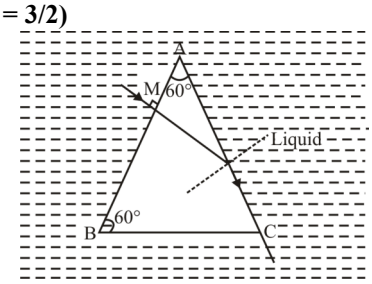


ISC-2004

127. Calculate the critical angle for glass and water pair. (Take refractive index for glass is 1.50 and the refractive index for water is 1.33).

ISC-2010

128. Find the refractive index of the liquid if a ray of light strikes surface AB normally and then comes out from face AC at grazing emergence. (${}^a\mu_g = 3/2$)



ISC-2004

129. A point object in air is placed symmetrically at a distance of 60 cm in front of a concave spherical surface of refractive index 1.5. If the radius of curvature of the surface is 20 cm, find the position of the image formed.

CBSE-2023

130. For a glass prism of refractive index $\sqrt{3}$, the value of angle of minimum deviation δ is equal to the angle of prism A. Find the angle of prism A. How will the angle δ be affected if the prism were immersed in water ?

CBSE-2022

131. A point source in air is kept 24 cm in front of a concave spherical glass surface (${}_a\mu_g = 1.5$) and radius of curvature 60 cm. Find the nature of the image formed and its distance from the point source.

CBSE-2022

132. A magician during a show makes a glass lens with n = 1.47 disappear in a trough of liquid.

(a) What is the refractive index of the liquid?

(b) Could the liquid be water?

Kerala Board-2020

133. A ray of light undergoes refraction when it enters from air to glass.

(a) Critical angle for glass liquid boundary is $\sin^{-1}$ (8/9). Determine the speed of light in liquid if speed of light in glass is 2×10^8 m/s.

Kerala Board-2017

134. If the difference in the velocities of light in glass and water is 0.25×10^8 m/s, calculate the velocity of light in air. Given that refractive index of glass and water with respect to air are 1.5 and $\frac{4}{3}$ respectively.

Maharashtra Board-2020

135. A blue ray of light enters an optically denser medium from air. What happens to its frequency in denser medium?

Karnataka Board-July, 2018

136. Write the two conditions for total internal reflection to takes place.

Karnataka Board-July, 2015

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137. Mention the laws of refraction of light.
Uttarakhand Board-2022

138. Write two definitions of refractive index.
Bihar Board-2021

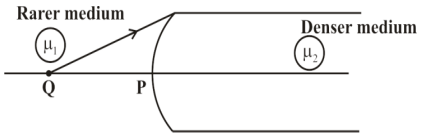
139. If the critical angle of total internal reflection from vacuum to any medium is 30°, what will be the value of speed of light in the medium ?
Bihar Board-2022

140. Write down the relationship between critical angle and refractive index.
Bihar Board-2022

Section-C (Short Answer)

141. What is total internal reflection of light? What are the two essential conditions for total internal reflection to take place?
Punjab Board-2018

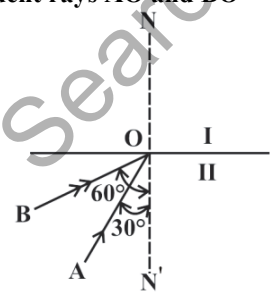
142. State Snell's law of refraction. A spherical surface of radius of curvature R separates a rarer and a denser medium as shown in the figure below:



Complete the path of the ray of light, showing the formation of a real image. Derive the relation connecting object distance u, image distance v, radius of curvature R and the refractive indices μ_1 and μ_2 of the two media.
Meghalaya Board-2018

143. Under what is the phenomenon of total internal reflection of light observed? Obtain the relation between the critical angle of incidence and the refractive index of the medium.
CBSE-2019

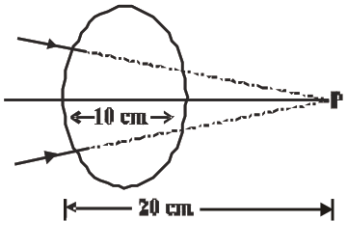
144. Give the critical angle of medium II w. r. t. I to be 45°, complete the following ray diagram for the incident rays AO and BO



Meghalaya Board-2013

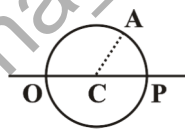
145. Define critical angle. The refractive indices of water and glass are $\frac{4}{3}$ and $\frac{3}{2}$ respectively. Find the critical angle for light ray incident from glass on water.
UP Board-2017

146. A converging beam of light travelling in air converges at a point P as shown in the figure. When a glass of refractive index 1.5 is introduced in between the path of the beam, calculate the new position of the image. Also draw the ray diagram for the image formed.



CBSE-2019

147. A point 'O' marked on the surface of a glass sphere of diameter 20 cm is viewed through glass from the position directly opposite to the point O. If the refractive index of the glass is 1.5, find the position of the image formed. Also, draw the ray diagram for the formation of the image.



CBSE-2019

148. A ray of light is incident on a glass prism of refractive index μ and refracting angle A. If it just suffers total internal reflection at the other face, obtain a relation between the angle of incidence, angle of prism and critical angle.
CBSE-2023

149. Define critical angle for a given pair of media and total internal reflection. Obtain the relation between the critical angle and refractive index of the medium.
CBSE-2023

150. A picture is painted with blue, green and red colours. A glass slab is placed on this picture. Will the images of all these colours lie in the same plane in the slab when viewed from the top of the glass slab? Why?
Kerala Board-2017

151. Refractive indices of water and glass are 4/3 and 3/2 respectively. A ray of light travelling in water is incident on the water-glass interface at 30°. Calculate the angle of refraction.
Meghalaya Board-2021

Section-D (Case-Based Questions)

152. Owais was very happy to receive a car on his birthday from his father. Then Owais and his friend Basit went for a long drive at night. Basit suggested Owais to get the tubes of his

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headlight replaced with high power tubes. as the headlight according to him were weak. Owais did so and again went for long with his friend to check the new headlighs. As they were enjoying the drive. suddenly a scooter coming form opposite side struck their car. Luckily nobody was hurt but the vehicles got badly damaged. Baisty slapped the scooterist but the scooterist said that the headlights of the car made him blind and he could not see anything. Owais's father became very angry with Owais and told him that he should have installed special cover on the headlights to reduce the glare. Now, answer the following.

(a) What is the special cover reducing the glare called. Mention its two other applications.

(b) What is your opinion about Owais and Basit's behaviour?

(c) What do you think about the reaction of Owais's father?

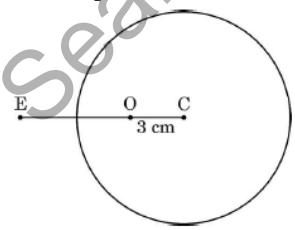
(d) Name and state the law that relates refractive index of the material cover with the angle at which reflected light and refracted light are perpendicular to each other.

J&K Board-2022

Section-E (Long Answer)

153. (i) A spherical surface of radius of curvature R separates two media of refractive indices n_1 and n_2. A point object is placed in front of the surface at distance u in medium of refractive index n_1 and its image is formed by the surface at distance v, in the medium of refractive index n_2. Derive a relation between u and v.

(ii) A solid glass sphere of radius 6.0 cm has a small air bubble trapped at a distance 3.0 cm from its centre C as shown in the figure. The refractive index of the material of the sphere is 1.5. Find the apparent position of this bubble when seen through the surface of the sphere from an outside point E in air.



CBSE-2023

154. With the help of a neat ray diagram, derive the relationship between the focal length, the object distance and the image distance for a concave mirror a concave mirror is first kept in a medium of refractive indexes × 1.33 and then in another medium of refractive index × 1.4 What will be the change in its focal length ?

Goa Board-2018

155. A spherical surface of radius of curvature R separates a rarer and a denser medium. With the help of a neat ray diagram obtain the relationship between the object distance 'u the image distance v' the radius of curvature 'R' and the refractive indices n_1 and n_2 of the two media, when the object is kept in the rarer medium. How does the scattering of light vary with the wavelength of different colors of light?

Goa Board-2018

IV. Refraction Through Spherical Surfaces, Lenses and Makers Formula

Section-A (Multiple Choice Questions)

156. The radius of curvature of curved surface at a thin planoconvex lens is 10 cm and the refractive index is 1.5. If the plane surface is silvered then the focal length will be:

(a) 20 cm (b) 5 cm
(c) 10cm (d) 15cm

Tamil Nadu Board-2023

Ans. (c) :

157. What will be the focal length of a convex lens whose power is + 2.5D?

(a) 50cm (b) 25cm
(c) 250 cm (d) 40 cm

Rajasthan Board-2023

Ans. (d) :

158. A convex lens (n = 1.5) is immersed in water (n = 1.33), then it will behave as a.

(a) Converging lens (b) Diverging lens
(c) Prism (d) Concave mirror

Bihar Board-2019

Ans. (a) :

159. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then, its focal length will.

(a) become zero
(b) become infinite
(c) remain unchanged
(d) become small, but non-zero

Nagaland Board-2018

Ans. (b) :

160. Two lenses of power + 12D and – 2D are combined together. What is their equivalent focal length?

(a) 8.33 cm (b) 10 cm
(c) 14 cm (d) 12.5 cm

Nagaland Board-2021

Ans. (b) :

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161. A convex lens of focal length 40cm is in contact with a concave lens of focal length 25cm. The power of the combination is

(a) +6.5 D (b) –1.5 D
(c) +1.5 D (d) –6.5 D

Nagaland Board-2020

Ans. (b) :

162. Double-convex lenses are to be manufactured from a glass of refractive index 1.5, with both faces of the same radius of curvature. If the focal length is to be 20 cm, radius of curvature required is:

(a) 10 cm (b) 15 cm
(c) 20 cm (d) 30 cm

Haryana Board-2022

Ans. (c) :

163. The focal length of a lens of power +4D is:

(a) – 25 cm (b) + 25 cm
(c) – 4 cm (d) + 4 cm

Haryana Board-2018

Ans. (b) :

164. The focal length of a lens of power –4D is:

(a) + 25 cm (b) + 4 cm
(c) – 25 cm (d) – 4 cm

Haryana Board-2018

Ans. (c) :

165. The focal length of a lens of power +2D is:

(a) + 50 cm (b) – 50 cm
(c) + 2 cm (d) – 2 cm

Haryana Board-2018

Ans. (a) :

166. The power of a lens of focal length 0.5 m is:

(a) + 5D (b) + 2D
(c) –5D (d) + 1D

Haryana Board-2018

Ans. (b) :

167. The power of a lens of focal length 0.25 m is:

(a) 0.25 D (b) + 4 D
(c) + 1 D (d) + 2.5 D

Haryana Board-2016

Ans. (b) :

168. The radii of curvature of both the sides of a convex lens are 15 cm and if the refractive index of the material of the lens is 1.5, then focal length of lens in air is ———cm.

(a) 20 (b) 15
(c) 10 (d) 30

Gujarat Board- May, 2021

Ans. (b) :

169. Dimensional formula for power of lens is ___.

(a) $M^0L^1T^0$ (b) $M^1L^2T^{-3}$
(c) $M^0L^{-1}T^0$ (d) $M^1L^{-1}T^{-1}$

Gujarat Board- August, 2020

Ans. (c) :

170. The minimum distance between an object and its real image formed by a convex lens of focal length f is :

(a) f (b) 2f
(c) 3f (d) 4f

CBSE-2023

Ans. (d) :

171. A biconvex lens of focal length f is cut into two identical plano convex lenses. The focal length part will be

(a) f (b) f/2
(c) 2f (d) 4f

CBSE-2020

Ans. (c) :

172. A biconcave lens of power P vertically splits into two identical Plano concave parts. The power of each part will be

(a) 2P (b) P/2
(c) P (d) $P/\sqrt{2}$

CBSE-2020

Ans. (b) :

173. A biconvex lens of glass having refractive index 1.47 is immersed in a liquid. It becomes invisible and behaves as a plane glass plate. The refractive index of the liquid is

(a) 1.47 (b) 1.62
(c) 1.33 (d) 1.51

CBSE-2020

Ans. (a) :

174. A window is provided in the middle of a wall. Its image is obtained on the opposite wall at a distance 'd' from it using a lens. If the window and its image are of the same size, then the focal length of the lens used is

(a) $+\frac{d}{4}$ (b) $+\frac{d}{2}$
(c) $-\frac{d}{4}$ (d) $-\frac{d}{2}$

CBSE-2020

Ans. (a) :

175. Equivalent focal length of two lenses in contact having power –15 D and + 5 D will be.

(a) –20cm (b) –10cm
(c) +10cm (d) +20cm

Bihar Board-2019

Ans. (b) :

176. Which of the following eye defects is removed by a convex lens ?

(a) Myopia (b) Hypermetropia
(c) Presbyopia (d) Astigmatism

Bihar Board-2021

Ans. (b) :

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177. When we see an object the image of the object formed on the retina is

(a) real and erect (b) real and inverted
(c) virtual and erect (d) virtual and inverted

Bihar Board-2022

Ans. (b) :

178. Cylindrical lenses are used to correct the eye defect called

(a) myopia (b) hypermetropia
(c) astigmatism (d) presbyopia

Bihar Board-2022, 2019

Ans. (c) :

179. The power of a convex lens of focal length 20 cm is

(a) –10 dioptre (b) +10 dioptre
(c) –5 dioptre (d) +5 dioptre

Bihar Board-2022

Ans. (d) :

180. A convex lens of focal length 40 cm and a concave lens of focal length 20 cm are in contact. The power of their combination in dioptre is

(a) 2.5 (b) –2.5
(c) 7.5 (d) –7.5

Bihar Board-2023

Ans. (b) :

181. The radius of curvature of each surface of a biconvex lens is 20 cm and the refractive index of the material of the lens is 1.5. The focal length of the lens is

(a) 20 m (b) 1/20 m
(c) 20 cm (d) 1/20 cm

Bihar Board-2023

Ans. (c) :

Section-B (Very Short Answer)

182. What is the main reason for axial chromatic aberration in the formation of images by a lens ?

ISC-2008

183. Draw a ray diagram for a convex lens illustrating linear chromatic aberration.

ISC-2007

184. For an achromatic combination of lenses in contact, why should the lens be of opposite nature ?

ISC-2005

185 An achromatic doublet of focal length 90 cm is to be made of two lenses, the material of one having 1.5 times the dispersive power of the other. The doublet is a converging type. Find the focal length of each of lens.

ISC-2003

186. (i) What is meant by
(a) spherical aberration
(b) chromatic aberration
(ii) How can spherical aberration be reduced/minimised ? Suggest any one method

ISC-2012, 2015

187. In an achromatic combination of two lenses, why should we have the materials of the lenses different ?

ISC-2002

188. What is chromatic aberration ? How can it be minimised or eliminated ?

ISC-2012, 2015

189. Two lenses of local lengths 0.20m and 0.30mm are kept in contact. Find the focal length of the combination.
Calculate power of two and combination.

Karnataka Board-March, 2014

190. An object of 3 cm is placed 14 cm in front of a concave lens of focal length 21 cm. Find the position, nature and size of the image formed.

Karnataka Board-July, 2019

191. The radii of two surfaces of a convex lens is 0.2 m and 0.22 m. Find the focal length of the lens if refractive index of the material of lens is 1.5. Also find the change in focal length, if it is immersed in water of refractive index 1.33.

Karnataka Board-July, 2018

192. An object is placed in front of a lens which forms its erect image of magnification 3. The power of the lens is 5 D. Calculate the distance of the object and the image from the lens.

CBSE-2023

193. Two lenses of power + 15D and –5D are in contact with each other. What is the focal length of combination?

Punjab Board-2018

194. A Biconvex lens of glass has both radius of curvature 30cm. Find the focal length of the lens in air. When this lens is immersed in a transparent liquid, its focal length becomes 120 cm. Find the refractive index of the liquid?

Uttarakhand Board-2023

195. What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm? Is the system a converging or a diverging lens? Ignore thickness of the lenses.

Manipur Board-2022

196. Determine the refractive index of the material of a biconvex lens of radius 5 cm to have a power of 5 dioptre.

Odisha Board-2020

197. A convex lens has focal length 5 m. At what distance should an object be placed so as to have a real image magnified twice?

Odisha Board-2020

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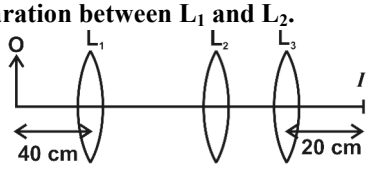
198. An image is placed 30cm away from a concave lens of focal length 15cm. Find the position, size and nature of the image.

Assam Board-2014

199. You are given three lenses L_1, L_2 and L_3, each of focal length 20 cm. An object is kept at 40 cm in front of L_1 as shown below. The final real image is formed at the focus of L_3, Find the separation between L_1 and L_2.



NIOS-2015

200. The radii of curvatures of the focus of a double convex lens are 10 cm and 15 cm its focal length is 12 cm. What is the refractive index of glass. (refractive index of air = 1)

MP Board-2023

201. A convex lens has 20 cm focal length in air. What is focal length in water? (Refractive index of air-water = 1.33, refractive index for air glass = 1.5)

MP Board-2023

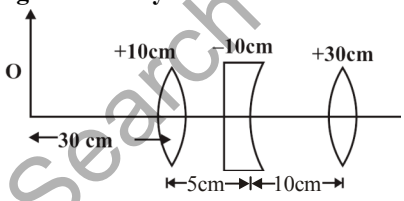
202. A convex lens of focal length 15 cm is kept in contact with a concave lens of focal length 20 cm. Find the focal length and power of combination.

Chhattisgarh Board-2023

203. A double-concave lens has radii of curvature 20 cm. If refractive index of lens with respect to air is 1.5, then calculate the focal length of the lens.

Chhattisgarh Board-2022

204. Three lenses of focal lengths +10 cm, –10 cm and + 30 cm are arranged coaxially as in the figure given below. Find the position of the final image formed by the combination.



CBSE-2019

205. The radii of curvature of the faces of a double-convex lens are 20 cm and 30 cm. Its power is $\frac{25}{6}$D . What is the refractive index of the glass of the lens ?

CBSE-2023

206. For a spherically curved surface, derive the relation

$$\frac{-n_1}{u}+\frac{n_2}{v}=\frac{n_2-n_1}{R}$$

Gujarat Board- May, 2021

207. Two thin lenses of power + 5 Dioptre and -3 Dioptre are placed in contact. Find the power of this combination.

Haryana Board-2022

208. Two concave lenses of focal length 20 cm each are placed in contact. What is the power of the compound lens ?

J&K Board-2017

209. If power of a lens is 5 dioptre, its focal length will be…….

J&K Board-2014, 2015

210. A concave lens of focal length 30cm and a convex lens of focal length 20 cm are placed in combination calculate the focal length on combination.

J&K Board-2018

211. Two lenses of powers –1.0 and 270 D are kept in contact. Find the focal length of combination.

J&K Board-2017

212. If a concave lens of 25 cm focal length is placed in contact with a convex lens of 20 cm focal length, then calculate the power of the combined lens formed by this combination.

Rajasthan Board-2022

213. Define focal length of a lens and calculate focal length of the lens having radius of curvature 30 cm.

Haryana Board-2018

214. An object is placed at a distance of 60 cm from a concave lens of focal length 15cm. Determine the magnification of the lens.

Jharkhand Board-2020

215. Find an expression for the equivalent focal length for a system of two thin lenses in contact.

Jharkhand Board-2018

216. The far point of a myopic person is 70 cm in front of the eye. Calculate the focal length and power of the lens needed by him to see the distant objects clearly.

Jharkhand Board-2018

217. Establish the relation amongst u, v and *f* for concave lens.

MP Board-2012

218. When an object is kept in between optical centre and focus in front of convex lens, draw ray-diagram of image formation.

MP Board-2014

219. What is meant by magnification of a lens? Write its expression.

MP Board-2015

220. $$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$$

When two thin lenses of focal lengths f_1 and f_2 are kept in contact, prove that their combined focal lengh 'f' is given by

MP Board-2022, 2018

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221. The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm and its focal length is 12 cm. What is the refractive index of glass?

MP Board-2019

222. What is the focus distance of combined lens made by combning a concave lenses of 30 cm focus distance placed in contact with a convex lens of 20 cm focus distance? Whether this combination is convergent lens or divergent?

Chhattisgarh Board-2021

223. Two lenses of power 8 D and –4 D are combined together. Calculate the focal length of the combined lens.

Chhattisgarh Board-2018

224 A lens whose power is +2D makes a combination with another lens of power –1D. What is the equivalent focal length of the combination ?

UP Board-2017

225. In which the power of a lens will be large - air or water ?

UP Board-2019

226. The power of a concaves lens and concave lens are 10 dioptre and 2 dioptre respectively. An object is placed at 25 cm from the combination of lenses in contact. Find the position of image of object. What will be the nature of the combined lens?

UP Board-2020

227. Define second focus of a concave lens.

UP Board-2020

228. The radius of curvatures of a double convex lens are 15 cm and 30 cm respectively. Find its focal length when it is immersed in a liquid of refractive index 1.65. Refractive index of glass is 1.5. What is the nature of lens in the liquid?

UP Board-2022

229. The focal lengths of convex and concave lenses are 10 cm and 50 cm respectively. Both lenses are kept in contact. An object is placed at a distance of 25 cm from this combination. Find the position of the image of the object.

UP Board-2022

230. A converging lens of focal length 40cm is kept in contact with a diverging lens of focal length 30 cm. Find the focal length of the combination.

ISC-2017

231. How can the spherical aberration produced by a lens be minimised ?

ISC-2017

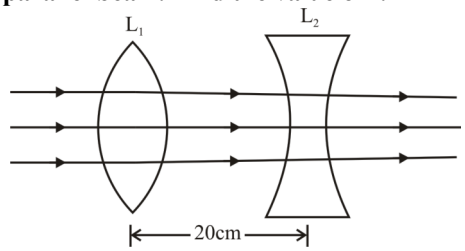
232. How does focal length of a convex lens change with increase in wavelength of incident light ?

ISC-2014

233. Find the focal length and nature of a lens whose optical power is –5 D.

ISC-2013

234. A thin convex lens (L_1) of focal length 80 cm and thin concave lens (L_2) of focal length f are kept co-axially, 20 cm apart as shown in figure below. When a narrow and parallel beam of light is incident on the convex lens, beam emerging from the concave lens is also a parallel beam. Find the value of f.



ISC-2012

235. A thin converging lens of focal length 15 cm is kept in contact with a thin diverging lens of focal length 20cm. Find the focal length of this combination.

ISC-2009

236. A biconvex spherical lens has focal length 20 cm. If it is split into two halves to form two plano-convex lenses, what is the focal length of each plano-convex lens ?

ISC-2007

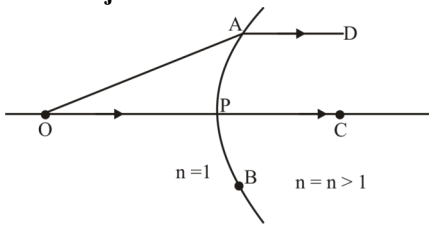
237. Refractive index of the material of concave lens is μ. The lens is immersed in a medium of refractive index μ_1 ($\mu_1 > \mu$). A parallel beam of light is incident on the lens. Draw a diagram to show the path of emergent rays.

ISC-2005

238. State one assumption made in deriving the formula $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ for refraction at spherical interface.

ISC-2003

239. In the figure shown, O is point object placed in air on the axis of a spherical surface APB of a glass block. OA is an incident ray. The direction of the refracted ray AD in the glass block is parallel to the principle axis PC, CP = CA = R is the radius of the spherical surface. Use the formula given in Q. No. 5 and show that the object distance



PO = u = R/(n–1), where n_2 = n and n_1 = 1.

ISC-2003

240. Write down the lens maker's formula using standard symbols.

Kerala Board-2021

ISC-2002

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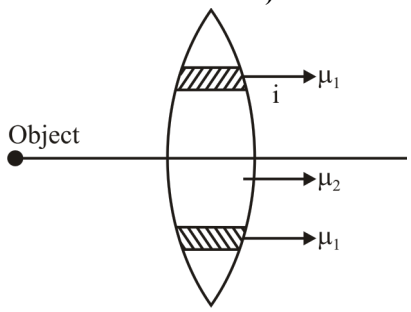
241. The lens shown in figure is made of two different materials of refractive indices μ_1 and μ_2, respectively. A point object is placed on the principal axis. How many images of the object will be formed by the lens (neglecting spherical and chromatic aberration) ?



ISC-2001

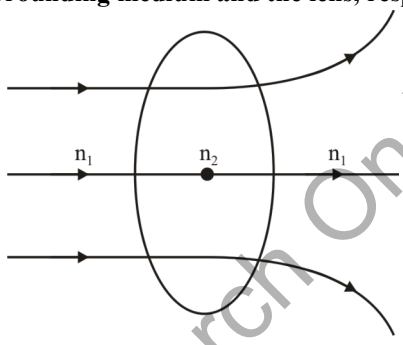
242. Draw a diagram to illustrate spherical aberration of a convex lens.

ISC-2001

243. Two thin lenses–one convex and the other concave of focal lengths 15 cm and 20 cm respectively, are put in contact. Find the focal length of the doublet lens.

ISC-2000

244. What is the relation between the refractive indices n_1 and n_2, if the behaviour of light rays is as shown in the given figure ?
Here, n_1 and n_2 are the refractive indices of the surrounding medium and the lens, respectively.



ISC-2000

245. State how focal length of a glass lens (refractive index 1.56) changes when it is completely immersed in.
(i) water (refractive index = 1.33)
(ii) a liquid (refractive index = 1.65)

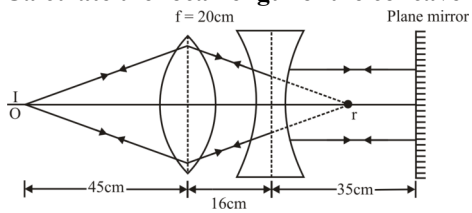
ISC-2016

246. When two thin lenses of focal lengths f_1 and f_2 are kept co-axially and in contact, prove that their combined focal length f is given by

$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$$

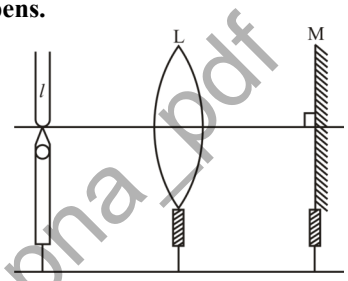
ISC-2014, 2008

247. The figure below shows the positions of a point object O, two lenses, a plane mirror and the final image I which coincides with the object. The focal length of the convex lens is 20 cm. Calculate the focal length of the concave lens.



ISC-2014

248. A convex lens L and a plane mirror M are arranged as shown in the figure alongside.
Position of object pin O is adjusted in such a way that the inverted image I formed by the lens mirror combination coincides with the object pin O. Explain how and when this happens.



ISC-2013

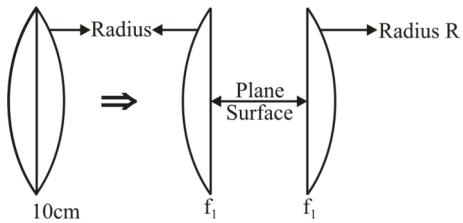
249. Where should an object be kept on the principal axis of a convex lens of focal length 20 cm in order to get an image, which is double of the size of the object ?

ISC-2011

250. Obtain an expression for refraction at a single convex spherical surface, i.e. the relation between μ_1 (rarer medium), μ_2 (denser medium), the object distance u, image distance v and radius of curvature R.

ISC-2011

251. An equi-convex lens of glass having focal length of 10 cm is split into two identical plano-convex lenses each having focal length f_1 as shown below. Find the value of f_1.



ISC-2010

252. An illuminated point object O is kept 20 cm from a thin convex lens L_1 of focal length 15 cm as shown below. A thin diverging lens L_2 of focal length 25 cm is kept co-axial with the first lens and 35 cm from it as shown in the figure.
Find the position of the final image formed by this combination of lenses.

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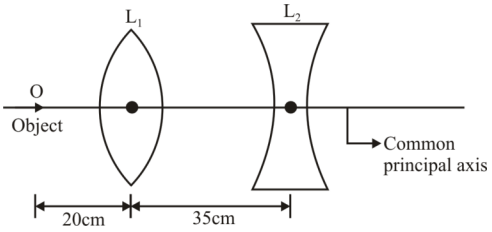


ISC-2010

253. A thin convex lens which is made of glass (refractive index 1.5) has a focal length of 20 cm. It is now completely immersed in a transparent liquid having refractive index 1.75. Find the new focal length of the lens.

ISC-2009

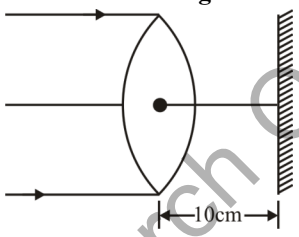
254. A plano-convex lens made of glass (n = 1.5) has a focal length 10 cm.
(i) Calculate the radius of curvature of its curved surface.
(ii) If an identical plano-convex lens is placed in contact with the first (plane surfaces facing each other), what will be the power (in dioptres) of the combination ?

ISC-2007

255. What is the cause of spherical aberration in lenses ? State a method to minimise the defect.

ISC-2006

256. A convex lens and a plane mirror are kept at a distance of 10 cm as shown in the diagram below. Parallel rays incident on the convex lens after reflection from the mirror form an image at the optical centre. Complete the ray diagram and find out the focal length of the lens.

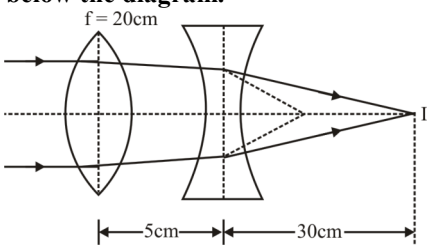


ISC-2005

257. The sun glasses have curved surfaces, but their power zero. Why ?

ISC-2005

258. See below the diagram.



Calculate the focal length of concave lens with the help of above ray diagram. The focal length of convex lens is 20 cm.

ISC-2004

259. A convex lens of focal length f = 20 cm is combined with a diverging lens of power 6.5 D. What are the power and focal length of the combination ?

ISC-2003

260. A plano-convex lens has radius of curvature 10 cm. Its focal length is 80 cm under water. Calculate the refractive index of the material of the lens, given refractive index of water is 4/3.

ISC-2002

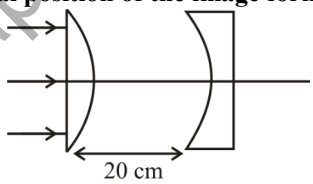
261. A beam of light converges at a point P. Now a convex lens is placed in the path of the convergent beam at 15 cm from P. At what point does a beam converge if the convex lens has focal length 10 cm.

CBSE-2019

262. Calculate the radius of curvature of an equi-concave lens of refractive index 1.5, when it is kept in a medium of refractive index 1.4, to have a power of –5D ?

CBSE-2019

263. In the given figure the radius of curvature of curved face in the planoconvex and the plano-concave lens is 15 cm each. The refractive index of the material of the lenses is 1.5. Find the final position of the image formed.



CBSE-2023

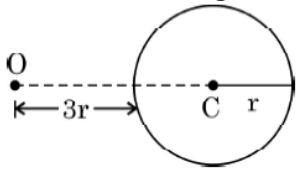
264. The power of a thin lens is +5 D. When it is immersed in a liquid, it behaves like a concave lens of focal length 100 cm. Calculate the refractive index of the liquid. Given refractive index of glass = 1.5.

CBSE-2023

265. A double-convex lens of power 4 D is manufactured from a glass of refractive index 1.5. What is the radius of curvature of each face of this lens if both faces have the same radius of curvature ?

CBSE-2023

266. (a) An object is placed in front of a converging lens. Obtain the conditions under which the magnification produced by the lens is (i) negative and (ii) positive.
(b) A point object is placed at O in front of a glass sphere as shown in figure.



Show the formation of image by the sphere.

CBSE-2022

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267. **A thin equiconvex lens of radius of curvature R made of material of refractive index μ_1 is kept coaxially, in contact with an equiconcave lens of the same radius of curvature and refractive index μ_2 (> μ_1).**
Find :
(i) the ratio of their powers, and
(ii) the power of the combination and its nature.
CBSE-2022

268. **A converging lens of focal length f_1 is placed coaxially in contact with a diverging lens of focal length f_2($f_1 > f_2$). Determine the power and nature of the combination in terms of f_1 and f_2.**
CBSE-2020

269. **The refractive index of the material of a converging lens is 1·5. If air is replaced by a medium of refractive index 1·6, then the lens will now behave as a _____ lens.**
CBSE-2020

270. **The focal length of an equiconcave lens is $\frac{3}{4}$ times of radius of curvature of its surfaces. Find the refractive index of the material of the lens. Under what condition will this lens behave as a converging lens?**
CBSE-2020

271. **Find the two possible position of an object kept in front of a lens of +5.0 D so, that the image formed in both cases is four times magnified.**
CBSE-2022, 2020

272. **A thin equiconvex lens of radius of curvature R made of material of refractive index μ_1 is kept coaxially, in contact with an equiconcave lens of the same radius of curvature and refractive index μ_2 (>μ) .**
Find
(i) the ratio of their powers and
(ii) the power of the combination and its nature.
CBSE-2020

273. **A biconvex lens made up of glass of refractive index 1.5, forms a real image of an object in air. If the whole set-up were immersed in a liquid of refractive index 1.7, then how will the nature of the image be affected?**
CBSE-2020

274. **Two lenses of powers +5D and –3D are in contact. Find the focal length of the combination**
Assam Board-2014

275. **(f)An object is placed at the focus of a Convex lens. Where will the image be formed?**
Assam Board-2017

276. **Using a suitable ray diagram prove that the radius of curvature of a spherical mirror is twice its focal length.**
Kerala Board-2021

277. **You are given two convex lenses of focal lengths 10 cm and 60 cm. To make a telescope, which of the two lenses will you use as object lens and which one as eye lens?**
Meghalaya Board-2018

278. **A convex lens is immersed in water. How is power of the lens affected ?**
Meghalaya Board-2017

279. **Show that the effective power of two thin lenses in contact is the sum of the power of each lens.**
OR
Derive the relationship between critical angle and refractive index.
Meghalaya Board-2023

280. **Find the power of a convex lens of focal length 20 cm.**
J&K Board-2020

281. **For which position of the object magnification of convex lens is – 1 (minus one)?**
Karnataka Board-March, 2019

282. **Two lenses of power +1.5D and -0.5D are kept in contact on their principal axis. What is the effective power of the combination?**
Karnataka Board-July, 2018

283. **How the power of a lens is related to its focal length?**
Karnataka Board-March,2015, 2016, 2017
Karnataka Board-July, 2017
Haryana Board-2017

284. **The radii of curvature of a double convex lens are 20 cm each and refractive index of the material of the lens is 1.5. What will be focal length of the lens?**
Uttarakhand Board-2020

285. **Write the formula and unit of 'Power of a lens'. What will be the power of a convex lens of focal length 50 cm ?**
Uttarakhand Board-2022

286. **Obtain the formula for combined focal length of two thin lenses in contact.**
Uttarakhand Board-2023, 2019

287. **Write the SI unit for power of a lens.**
Uttarakhand Board-2019

288. **Define power of a convex lens. What is it's unit?**
AP Board-2021

289. **Two lenses of power – 1.75 D and +2.25D respectively, are placed in contact. Calculate the focal length of the combination.**
AP Board-2020, 2019, 2023

290. **A convex lens of refractive index 1.5 is kept in a liquid medium having same refractive index. What is the focal length of the lens this medium ?**
Bihar Board-2023

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Section-C (Short Answer)

291. Show that the axial aberration ($f_R - f_V$) for a lens is equal to its mean focal length times the dispersive power of the material of the lens. Start with the lens maker's formula.

ISC-2001

292. What is chromatic aberration in lenses ? State the necessary conditions for an achromatic doublet. How are these conditions practically achieved ?

ISC-2000

293. What is meant by 'chromatic aberration' ? A thin convex lens of focal length 30 cm and made of flint glass (dispersive power = 0.03) is kept in contact with a thin concave lens of focal length 20 cm and made of crown glass. Calculate the dispersive power of crown glass if the above said combination acts as an achromatic doublet.

ISC-2007

294. The diameter of a plano - convex lens is 6 cm and its thickness is 3mm. Determine the focal length of the lens. Speed of light in the material of lens is 2×10^8 m/s.

UP Board-2022

295. (i) Define SI unit of power of a lens.

(ii) A plano convex lens is made of glass of refractive index 1.5. The radius of curvature of the convex surface is 25 cm.

(ii, i) Calculate the focal length of the lens.

(ii, ii) If an object is placed 50 cm in front of the lens, find the nature and position of the image formed.

CBSE-2022

296. What focal length should the reading spectacles have for a person for whom the least distance of distinct vision is 50 cm? What is the nature of the lens ?

Nagaland Board-2021

297. An object of size 3.0 cm is placed 14 cm in front of a concave lens of focal length 21 cm. Find the position, nature and size of image.

Nagaland Board-2021

298. ii). The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm, its focal length is 12cm. What is the refractive index of glass ?

Nagaland Board-2020

299. A convex lens has 20 cm focal length in air. What is the focal length in water ? [Refractive index of water = 1.33, Refractive index of air-glass = 1.5]

Nagaland Board-2020

300. a) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. Its focal length is 12 cm. What is the refractive index of glass?

b) A convex lens has 15 cm focal length in air. What is focal length in water?

(Retractive index of air-water = 1.33 and Refractive index of air-glass = 1.5)

Gujarat Board-March, 2022

301. The magnifying power of an objective lens of a compound microscope is 8 if the magnifying power of the compound microscope is 32. Then calculate magnifying power of an eyepiece lens.

MP Board-2015

302. Establish the relation $\frac{1}{f} = \frac{1}{v} = \frac{1}{u}$ for a convex lens, where symbols have their usual meanings.

MP Board-2019

303. The focal lengths of a convex lens and concave lens are 10 cm and 50 cm respectively. Both lenses are kept in contact. An object is placed at a distance of 25 cm from this combined lens. Determine the position of image of the object.

UP Board-2019

304. Two thin lenses are placed in contact. Focal length of each lens is 20 cm. Distance of object from combined lens is 20cm. Find the distance between object and image if both the lenses are (i) convex and (ii) concave.

UP Board-2021

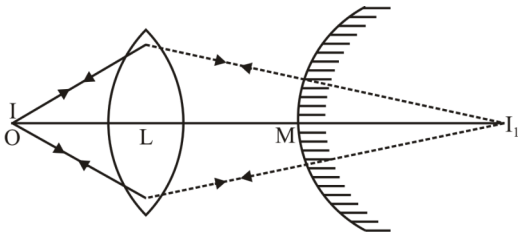
305. Equiconcave lens of crown glass has to be made. How much radii of the surfaces of the lens be kept so that its power would be –2.5D? The refractive index of crown glass is 1.65.

UP Board-2023

306. Starting with an expression for refraction at a single spherical surface, obtain lens maker's formula.

ISC-2017

307. A point object O is placed at a distance of 15 cm from a convex lens L of focal length 10 cm as shown in the figure below. On the other side of the lens, a convex mirror M is placed such that its distance from the lens is equal to the focal length of the lens. The final image formed by this combination is observed to coincide with the object O. Find the focal length of the convex mirror.



ISC-2015

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308. When a convex lens of focal length 30 cm is in contact with a concave lens of focal length 20 cm, find out if the system is converging or diverging.

CBSE-2019

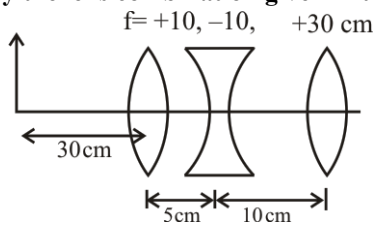
309. A screen is placed 90 cm from an object. The image of the object on the screen is formed by a convex lens at two different positions separated by 20 cm. Calculate the focal length of the lens.

CBSE-2019

310. A convex lens of focal length 20 cm and a concave lens of focal length 15 cm are kept 30 cm apart with their principal axes coincident. When an object is placed 30 cm in front of the convex lens, calculate the position of the final image formed by the combination. Would this result change if the object were placed 30 cm in front of the concave lens? Give reason.

CBSE-2019

311. Determine the position of the image formed by the lens combination given in the figure.



CBSE-2019

312. A beam of light converges at a point P. Draw ray diagrams to show where the beam will converge if (i) a convex lens, and (ii) a concave lens is kept in the path of the beam.

CBSE-2019

313. An equiconvex lens forms a two times enlarged real image when an object is kept 16 cm from it. The lens is cut into two identical plano-convex lenses. If the object is again kept 16 cm in front of one of these lenses, then find the nature and position of the image formed.

CBSE-2022

314. A converging lens made of glass (μ = 1·5) has its spherical faces of radii of curvature 10 cm and 20 cm. Find its focal length

(a) in air, and

(b) when it is immersed in a liquid of refractive index 1·25.

CBSE-2022

315. An object is placed 30 cm in front of a plano-convex lens with its spherical surface of radius of curvature 20 cm. If the refractive index of the material of the lens is 1.5 , find the position and nature of the image formed.

CBSE-2020

316. A Convex lens and a Concave lens of focal length 0.1m each are placed co-axially 0.03m apart. Find the position of the image of an object placed 0.15m in front of the Convex lens.

Assam Board-2017

317. Two identical equiconvex lenses of refractive index $\frac{3}{2}$ and focal length 16cm are kept in contact. The space between the lenses is filled with water of refractive index $\frac{4}{3}$. What is the focal length of the combination?

Assam Board-2016

318. Deduce the relation $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ for a convex lens producing virtual image.

CBSE-2020

Assam Board-2015

319. Derive the expression for the equivalent focal length of a combination of two thin convex lenses in contact.

Meghalaya Board-2019, 2021

Karnataka Board-March, 2016

Assam Board-2015

320. Using a suitable ray diagram derive the relation $\frac{n_2}{v}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$ for refraction at a spherical surcface.

Kerala Board-2021

Assam Board-2014

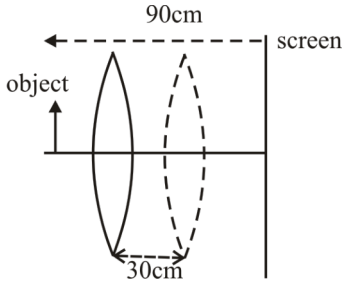
321. Explain the refraction at a spherical surface using a schematic diagram.

Kerala Board-2014

322. The radius of curvature of either face of a convex lens is equal to its focal length. Calculate the refractive index of the material of the lens.

Goa Board-2023

323. A screen is placed at a distance of 90 cm form an object. A convex lens form the image of this object on the screen, when placed at two different locations separated by 30cm as shown in the figure. Determine the focal length of the lens.



Goa Board-2018

324. Derive the expression for effective focal length of two thin lenses kept in contact.

Karnataka Board-July, 2018

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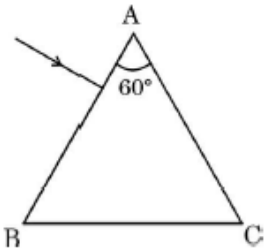
325. **Derive Lens Maker's formula $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ for the focal length of a thin lens. Here the signs used have the usual meaning.**

Bihar Board-2023
Uttarakhand Board-2022
Jharkhand Board-2022

Section-D (Case-Based Questions)

326. **Strontium titanate is a rare oxide – a natural mineral found in Siberia. It is used as a substitute for diamond because its refractive index and critical angle are 2.41 and 24.5 , respectively, which are approximately equal to the refractive index and critical angle of diamond. It has all the properties of diamond. Even an expert jeweller is unable to differentiate between diamond and strontium titanate. A ray of light is incident normally on one face of an equilateral triangular prism ABC made of strontium titanate.**



Answer the following questions based on the above :

(a) Trace the path of the ray showing its passage through the prism.
(b) Find the velocity of light through the prism.
(c) Briefly explain two applications of total internal reflection.

CBSE-2023

327. **The lens maker's formula is useful to design lenses of desired focal lengths using surfaces of suitable radii of curvature. The focal length also depends on the refractive index of the material of the lens and the surrounding medium. The refractive index depends on the wavelength of the light used. The power of a lens is related to its focal length.**

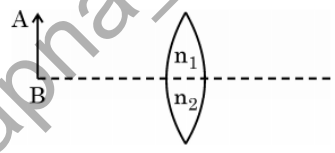
Answer the following questions based on the above :

(a) How will the power of a lens be affected with an increase of wavelength of light ?
(b) The radius of curvature of two surfaces of a convex lens is R each. For what value of μ of its material will its focal length become equal to R ?
(c) The focal length of a concave lens of μ = 1·5 is 20 cm in air. It is completely immersed in water of μ = $\frac{4}{3}$. Calculate its focal length in water.

CBSE-2023

328. **A lens is a transparent optical medium bounded by two surfaces; at least one of which should be spherical. Considering image formation by a single spherical surface successively at the two surfaces of a lens, lens maker's formula is obtained. It is useful to design lenses of desired focal length using surfaces of suitable radii of curvature. This formula helps us obtain a relation between u, v and f for a lens. Lenses form images of objects and they are used in a number of optical devices, for example microscopes and telescopes.**

(i) An object AB is kept in front of a composite convex lens, as shown in figure. Will the lens produces one image? If not, explain.



(ii) A real image of an object formed by a convex lens is observed on a screen. If the screen is removed, will the image still be formed? Explain.
(iii) A double convex lens is made of glass of refractive index 1.55 with both faces of the same radius of curvature. Find the radius of curvature required if focal length is 20 cm.

CBSE-2023

329. **A lens is a portion of a transparent medium bounded by two surfaces and one of these surfaces is essentially spherical. It is used to converge or diverge the light incident on it. Power of a lens is the measure of its ability to converge or diverge the light incident on it. Power of a lens depends on the refractive index of the material of lens with respect to the surrounding medium and the radii of curvature of its two surfaces.**

(a) The power of a convex lens
(i) increases when the lens is dipped in water.
(ii) increases when the wavelength of incident light decreases.
(iii) decreases when another convex lens is placed in contact with it.
(iv) increases when the lens is cut into two identical plano-convex lenses.

(b) The focal length of a concave lens is 40 cm. The power of the lens is :

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(i) 0·025 D (ii) 2·5 D
(iii) –0·025 D (iv) –2·5 D

(c) The focal length of a concave lens (μ_g = 1·5) in air is 20 cm. What should be the refractive index of the surrounding medium so that the lens behaves as a converging lens of focal length 60 cm ?

(i) 1·4 (ii) 1·8
(iii) 1·7 (iv) 1·2

(d) Beams of red light, blue light, yellow light and violet light are incident on a convex lens, one-by-one. Which one of them converges nearest to the lens ?

(i) Blue light (ii) Violet light
(iii) Red light (iv) Yellow light

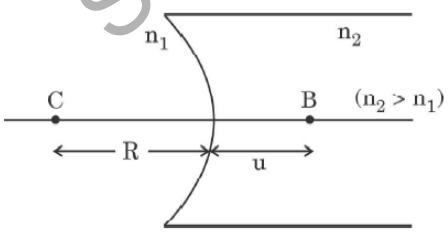
(e) A beam of light coming parallel to the principal axis of a convex lens L_1 of focal length 15 cm is incident on it. Another convex lens L_2 of focal length 25 cm is placed coaxially at a distance d from L_1. For the final image to be formed at infinity, the value of d should be :

(i) 10 cm (ii) 15 cm
(iii) 25 cm (iv) 40 cm

CBSE-2022

330. Two transparent media of refractive indices n_1 and n_2 are separated by a spherical transparent surface. The rays of light incident on the surface get refracted into the medium on the other side. The laws of refraction are valid at each point of the spherical surface. A lens is a transparent optical medium bounded by two surfaces, at least one of which should be spherical. The focal length of a lens is determined by the radii of curvature (R_1 and R_2) of its two surfaces and the refractive index (n) of the medium of the lens with respect to the surrounding medium. Depending on R_1 and R_2, a lens behaves as a diverging or a converging lens. The ability of a lens to diverge or converge a beam of light incident on it defines its power.

(a) An object is placed at the point B as shown in the figure. The object distance (u) and the image distance (v) are related as



(i) $\frac{1}{v}-\frac{1}{u}=\left(\frac{n_2-n_1}{n_1}\right)\frac{1}{R}$

(ii) $\frac{1}{v}-\frac{1}{u}=\left(\frac{n_1-n_2}{n_2}\right)\frac{1}{R}$

(iii) $\frac{n_2}{v}-\frac{n_1}{u}=\frac{(n_2-n_1)}{R}$

(iv) $\frac{n_1}{v}-\frac{n_2}{u}=\frac{(n_1-n_2)}{R}$

(b) A point object is placed in air at a distance 'R' in front of a convex spherical refracting surface of radius of curvature R. If the medium on the other side of the surface is glass, then the image is :

(i) real and formed in glass.
(ii) real and formed in air.
(iii) virtual and formed in glass.
(iv) virtual and formed in air.

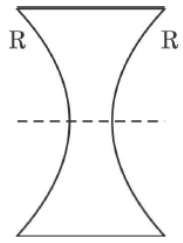
(c) An object is kept at 2F in front of an equiconvex lens. The image formed is :

(i) real and of the size of the object.
(ii) virtual and of the size of the object.
(iii) real and enlarged.
(iv) virtual and diminished.

(d) A thin converging lens of focal length 10 cm and a thin diverging lens of focal length 20 cm are placed coaxially in contact. The power of the combination is :

(i) –5 D (ii) + 5 D
(iii) + 15 (iv) –15 D

(e) An equiconcave lens of focal length 'f' is cut into two identical parts along the dotted line as shown in the figure. The focal length of each part will be :



(i) $\frac{f}{4}$ (ii) $\frac{f}{2}$
(iii) f (iv) 2f

CBSE-2022

331. Find an expression for the combined focal length of two thin coaxial convex lenses placed in contact.

CBSE-2019
Meghalaya Board-2014

Section-E (Long Answer)

332. Derive Lens Maker's formula for convex lens.

Karnataka Board-March, 2017
Karnataka Board-July, 2015, 2016

333. With the help of suitable diagram, sign conventions and assumptions, derive Lens Marker's formula for a convex lens.

Punjab Board-2018

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334. What is lens maker's formula? Derive an expression for lens Maker's formula for a convex lens.

J&K Board-2011, 2012, 2016, 2019, 2022
Karnataka Board- March, 2017, 2019
Meghalaya Board-2019
Jharkhand Board-2018
Nagaland Board-2017
Kerala Board-2017
Karnataka Board- July, 2015, 2016
Assam Board-2016
MP Board-2014, 2015

335. Stating the assumptions made and convention of signs used, derive the lens maker's formula in case of a double convex lens.

J&K Board-2023

336. What is a converging lens? Derive an expression for the lens maker's formula for a convex lens.

Nagaland Board-2017

337. Derive lens, maker's formula for thin lens.

Gujarat Board- July, 2022
Gujarat Board- March, 2020
CBSE-2020
Assam Board-2015

338. Describe the displacement method to determine the focal length of convex lens on the following points :
(i) Formula derivation;
(ii) Ray diagram;
(iii) Observation Table;
(iv) Precautions (any two)

MP Board-2012

339. Establish Lens maker's formula :

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Chhattisgarh Board-2020, 2023
Uttarakhand Board-2022
Jharkhand Board-2018, 2020
MP Board-2014, 2015
Assam Board-2013

340. Define deviation without dispersion. Derive an expression for its essential condition and resultant deviation.

MP Board-2014

341. For spherical refracting surface establish the refraction formula

$$\frac{\mu}{v} - \frac{1}{u} = \frac{\mu - 1}{R}$$

Where symbols have their usual meanings.

MP Board-2013, 2015

342. Describe the displacement method to determine focal length of Convex Lense under the following headings :
(i) ray diagram
(ii) formula derivation
(iii) Why the distance between two pins should be greater than 4f?

MP Board-2015

343. Two convex lenses A and B of focal lengths 15 cm and 10 cm respectively are placed coaxially 'd' distance apart. A point object is kept at a distance of 30 cm in front of lens A. Find the value of 'd' so that the rays emerging from lens B are parallel to its principal axis.

CBSE-2023

344. Two thin lenses L_1 and L_2, L_1 being a convex lens of focal length 24 cm and L_2 a concave lens of focal length 18 cm are placed coaxially at a separation of 45 cm. A 1 cm tall object is placed in front of the lens L_1 at a distance of 36 cm. Find the location and height of the image formed by the combination.

CBSE-2023

345. A converging lens of refractive index 1.5 has a power of 10 D. When it is completely immersed in a liquid, it behaves as a diverging lens of focal length 50 cm. Find the refractive index of the liquid.

CBSE-2020

346. A point object is placed at a distance of 12 cm on the principal axis of a convex lens of focal length 10 cm. A convex mirror is placed coaxially on the other side of the lens at a distance of 10 cm. If the final image coincides with the object, sketch the ray diagram and find the focal length of the convex mirror.

CBSE-2020

347. Derive an expression for refraction at a convex sphrical surface when object lies in the rarer medium of R.I. n_1 and real image is formed in the denser medium of R.I. n_2. Draw necessary ray diagram.
If the medium of R.I. n_2 is replaced by another medium of R.I. n_3 where $n_3 > n_2$, what would be the change in the image distance ?

Goa Board-2019

348. With a neat ray diagram, show the image formation in a convex lens and establish the relation among object distance, image distance and focal length.

Odisha Board-2022

349. Deduce the relation between n, u, v, Q, R for refraction at a spherical surface, where the symbols have their usual meaning.

Karnataka Board-July, 2018

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V. Refraction Through Prism

Section-A (Multiple Choice Questions)

350. The primary rainbow is a result of which of the following three- step process?
(a) Reflection, refraction and reflection
(b) Reflection, reflection and refraction
(c) Refraction, reflection and refraction
(d) Refraction, refraction and reflection

Gujarat Board- July, 2022
MP Board-2022

Ans. (c) :

351. Rainbow is a phenomena due to:
(a) Refraction
(b) Dispersion
(c) Total Internal Reflection
(d) All of the above

Haryana Board-2016, 2022

Ans. (d) :

352. The angle of minimum deviation for a prism is 30° and the angle of prism is 60° The refractive index of the material of the prism is:
(a) 2 (b) $\sqrt{2}$
(c) 1.5 (d) $\frac{1}{\sqrt{2}}$

Haryana Board-2022

Ans. (b) :

353. For a glass prism, the angle of minimum deviation will be smallest for the light of
(a) red colour. (b) blue colour
(c) yellow colour. (d) green colour.

CBSE-2020

Ans. (a) :

354. The working of a totally reflecting prism is based upon:
(a) Total internal reflection
(b) Reflection
(c) Refraction
(d) None of these

Haryana Board-2017

Ans. (a) :

355. A ray of light is incident normally on the surface of an equilateral prism made up of material with refractive index 1.5. The angle of deviation is ——.
(a) 60° (b) 45°
(c) 30° (d) 75°

Gujarat Board- May, 2021

Ans. (a) :

356. When the angle of incidence becomes equal to critical angle, which one of the following choice would be correct for the angle of refraction (r)?
(a) $r > 90^\circ$ (b) $r < 90^\circ$
(c) $r = 90^\circ$ (d) $r = 45^\circ$

Gujarat Board- July, 2022

Ans. (c) :

357. The angle of prism is 60°, angle of deviation is 30°, incident angle is i and emergent angle is e. For angle of minimum deviation the values of i and e will be :
(a) i = 45°, e = 30° (b) i = 30°, e = 45°
(c) i = 45°, e = 45° (d) i = 30°, e = 30°

Chhattisgarh Board-2018

Ans. (c) :

358. The refracting angle of prism is $1/2^0$ and its refractive index is 1.5 for yellow colour. Deviation of yellow light passing through it is:
(a) 2^0 (b) 1^0
(c) $1/2^0$ (d) $1/4^0$

NIOS-2019

Ans. (d) :

359. After passing through the prism, which colour of light has maximum deviation ?
(a) Red colour (b) Violet colour
(c) Blue colour (d) Green colour

UP Board-2019

Ans. (b) :

360. Deviation of a thin prism of refractive index n and angle of prism A is
(a) (1 – n) A (b) (n – 1) A
(c) (n + 1) A (d) $(1 + n) A^2$

Bihar Board-2019

Ans. (b) :

361. Blue colour of sky is due to
(a) reflection of light (b) refraction of light
(c) scattering of light (d) dispersion of light

Bihar Board-2022

Ans. (c) :

362. The process of splitting of light into seven colours through prism is called
(a) reflection (b) refraction
(c) dispersion (d) diffraction

Bihar Board-2022

Ans. (c) :

363. The critical angle for total internal reflection of a ray from any medium to vacuum is 30°. Then velocity of light in the medium will be
(a) 3×10^8 m/s (b) 1.5×10^8 m/s
(c) 6×10^8 m/s (d) 4.5×10^8 m/s

Bihar Board-2023

Ans. (b) :

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364. The dispersive power of a prism depends on
(a) Angle of incidence
(b) Nature of material of prism
(c) Refracting angle of prim
(d) Angle of prism

Bihar Board-2023

Ans. (b) :

Section-B (Very Short Answer)

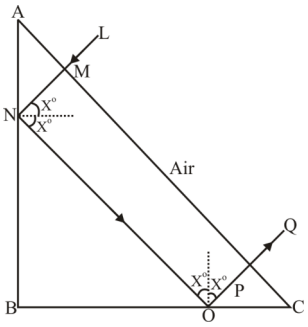
365. Why does the sky appear blue?

Punjab Board-2018

366. How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light?

CBSE-2019

367. A ray of light LM incident normally on the surface AC of an isosceles right angled prism ABC (where, AB = BC) emerges along PQ, parallel to LM, as shown in the figure below. What can you say about refractive index μ of the material of the prism ?



ISC-2011

368. At what angle should a ray of light be incident on the face of an equilateral prism, so that it just suffers totals internal reflection at the other face? The refractive index of the material of the prism is 1.5.

Karnataka Board-March, 2020

369. Calculate angle of minimum deviation for an equilateral triangular prism of refractive index $\sqrt{3}$.

J&K Board-2019

370. Define angle of minimum deviation. For a prism of angle A = 60^0, the angle of minimum deviation is 30^0. Calculate its refractive index of the material of the prism.

NIOS-2018

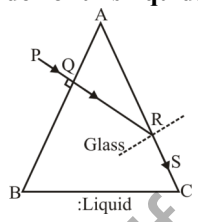
371. Define dispersive power of a prism. Calculate the dispersive power for a prism for following data. μ_C= 1.6444, μ_D= 1.6520 and μ_F = 1.6637, where C,D,F are the Fraunhofer nomenclatures (λ_F = 4861Å, λ_D = 5893Å, λ_C = 6563Å)

NIOS-2018

372. For a given source of light, the angle of minimum, deviation of a 60° prism is 40° What is its refractive index?

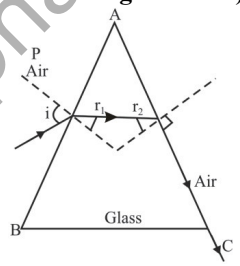
J&K Board-2011, 2015

373. A narrow beam of monochromatic light PQ is incident normally on one face of an equiangular glass prism of refractive index 1.45. When the prism is immersed in a certain 'liquid, the ray makes grazing emergence along the other face as shown in the figure. Find the refractive index of this liquid.



ISC-2014

374. At what angle, a ray of light should be incident on the first face AB of a regular glass prism ABC, so that the emergent ray grazes the adjacent face AB ?
(Refractive index of glass = 1.6)



ISC-2013

375. A ray of light is normally incident on one face of an equilateral prism. Trace the course of the ray through the prism and emerging from it.

ISC-2003

376. Derive; i +e = A + δ for a triangular glass prism.

Gujarat Board- March, 2020

377. Explain refraction through a prism and derive the equation δ = i + e – A.

Gujarat Board- August, 2020

378. Blue colours of sky is due to ..... .

MP Board-2015

379. Prove that-
$^a\mu_w \times {}^w\mu_g \times {}^g\mu_a = 1$
where the symbols their usual meanings.

MP Board-2018

380. Which colour of light is deviated maximum by a prism ?

Chhattisgarh Board-2023

381. Draw a graph showing variation of angle of deviation (D) with angle of incidence (i) of rays passing through a prism. Name the two factors on which angle of minimum deviation (δ) depends.

NIOS-2019

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382. Define dispersive power of the material of a prism.

UP Board-2017

383. If angle of the prism and the angle of minimum deviation are equal, then find the refractive index of interial of the prism.

UP Board-2020

384. Calculate dispersive power of a transparent material given :

$$n_v = 1.56,\ n_r = 1.54,\ n_y = 1.55$$

385. What are the dark lines seen in the solar spectrum called ?

ISC-2013

386. What conditions must be satisfied by two thin lenses kept in contact, so that they form an achromatic doublet, i.e. a combination free from chromatic aberration ?

ISC-2012

387. Name an optical device, which when used with a spectrometer, can determine the wavelength of the given monochromatic light.

ISC-2010

388. Calculate dispersive power of glass, accurately upto three decimal places from following data.

(i) Refractive index of glass for red colour = 1.60

(ii) Refractive index of glass for yellow colour = 1.61

(iii) Refractive index of glass for violet colour = 1.62

ISC-2010

389. State two basic differences between primary and secondary rainbows.

Bihar Board-2023

ISC-2006

390. Draw ray diagram to illustrate the formation of primary rainbow by refraction and total internal reflection of sunlight in water drops.

ISC-2005, 2003

391. Define dispersive power (for light) of a medium.

Bihar Board-2022

ISC-2003, 2021

392. The refractive indices of a material for red, violet and yellow colour lights are 1.52, 1.62 and 1.59 respectively. Calculate the dispersive power of the material. If the mean deviation is 40°, what will be the angular dispersion produced by a prism of this material ?

ISC-2006

393. How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light?

CBSE-2019

394. Under which conditions can a rainbow be observed ? Distinguish between a primary and a secondary rainbow.

CBSE-2019

395. Explain the following :

(a) Sky appears blue.

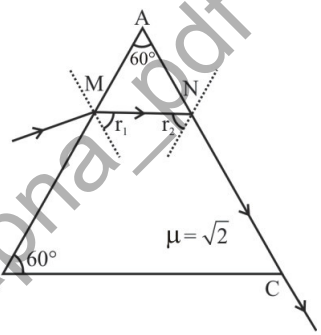
(b) The Sun appears reddish at (i) sunset, (ii) sunrise.

CBSE-2019

396. An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $4\sqrt{2}/5$.

CBSE-2019

397. A ray of light passes through a prism of refractive index $\sqrt{2}$ as shown in the figure. Find :



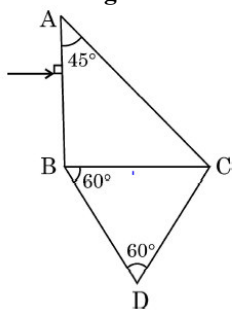
(i) The angle of incidence ($\angle r_2$) at face AC.

(ii) The angle of minimum deviation for this prism.

CBSE-2022

398. (a) Write two necessary conditions for total internal reflection.

(b) Two prisms ABC and DBC are arranged as shown in figure



The critical angles for the two prisms with respect to air are 41.1° and 45° respectively. Trace the path of the ray through the combination.

CBSE-2022

399. At sunset or sunrise, the _____ scattered coloured light from the sun reaches our eyes.

CBSE-2020

400. Out of red, blue and yellow lights, the scattering of _____ light is maximum.

CBSE-2020

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401. Draw the ray diagram showing the formation of primary rainbow with the total internal reflection and refraction of a ray of light inside a water drop.

Meghalaya Board-2021

402. Draw a ray diagram to show that a totally reflecting prism deviates a ray through 180°.

Meghalaya Board-2021

403. Draw the ray diagram showing the phenomenon of dispersion of light through a prism.

Meghalaya Board-2015

404. Why does sky look blue ?

J&K Board-2020

405. Draw a graph between angle of incidence and angle of deviation for a prism. Which color of light is deviated least by the prism?

Uttarakhand Board-2023

Section-C (Short Answer)

406. (a) Deduce the formula for refractive index n for the material of a prism in terms of angle of minimum deviation and angle of prism.

UP Board-2022, 2023

407. (b) (i) Trace the path of a ray of light PQ which is incident at an angle i on one face of a glass prism of angle A. It then emerges out from the other face at an angle e. Use the ray diagram to prove that the angle through which the ray is deviated is given by $\angle\delta = \angle i + \angle e - \angle A$.

(ii) What will be the minimum value of δ if the ray passes symmetrically through the prism?

CBSE-2020

408. Deduce the formula for refractive index of material of prism.

MP Board-2017

409. Draw a diagram to show how an image is produced by a pair of total reflecting prism arranged as in a periscope.

ISC-2001

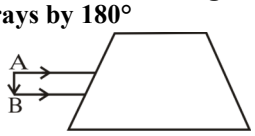
410. What is deviation without dispersion ? Obtain the conditions of deviation without dispersion by two thin prisms.

Bihar Board-2022

411. The refraction of light through the atmosphere is responsible for many interesting phenomena.

(a) How is the atmospheric refraction of sunlight affects the duration of a day?

(b) A prism shown in the figure is designed to bend the rays by 180°



Complete the ray diagram to show the image formation.

Kerala Board-2016

412. Show that in case of a prism. $A + \delta = i + e$ where symbols have their usual meanings.

J&K Board-2016

413. Define Scattering of light. Why sky appears blue?

J&K Board-2022

414. From a prism of refracting angle 60°, the angle of minimum deviation is 30° Calculate:

(i) the angle of incidence

(ii) the angle of refraction

(iii) the refractive index of material of prism.

MP Board-2018

415. A ray of white light splits into a pattern of its constituent colours as it passes through a glass prism. But it does not split when passed through a glass slab. Explain why ? Draw diagrams in support of your explanations.

NIOS-2022

416. Find the angle of incidence at which a ray of monochromatic light should be incident on the first surface AB of a regular glass prism ABC so that the emergent ray grazef the adjacent surface AC. (refractive index of glass = 1.56).

ISC-2016

417. Show that the axial chromatic aberration ($f_R - f_V$) for a convex lens is equal to the product of its mean focal length (f) and dispersive power of its material i.e. prove $f_R - f_V = \omega f$.

ISC-2013

418. Define dispersive power of the material of prism. The refractive indices of a prism for prism for violet, yellow and red colours are 1.632, 1.620 and 1.613 respectively. Calculate the dispersive power of the material of the prism.

ISC-2005

419. For any prism show that refractive index of its material is given by

$$n \text{ or } \mu = \sin\left(\frac{A+\delta_{min}}{2}\right) \Big/ \sin\left(\frac{A}{2}\right)$$

where, the terms have their usual meanings.

ISC-2010

420. A ray EF of monochromatic light is incident on the refracting surface AB of a regular glass prism (refractive index = 1.5) at an angle of incident of i = 55°. If it emerges through the adjacent face AC, calculate the angle of emergence 'e'

ISC-2010

421. In the figure, ABC is the cross-section of a right angled prism with angle B = 60° and angle A = 30°. PQ is a ray incident normally at Q. Copy the diagram and complete the passage of the ray through the prism. Explain briefly what happens at the interfaces between glass and air ? Calculate sin i_2, where i_2 is the angle of emergence in air. Take critical angle for glass as 42° and refractive index of glass is 1.5.

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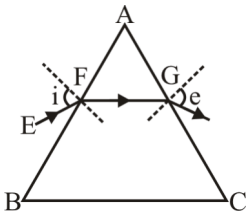


ISC-2007

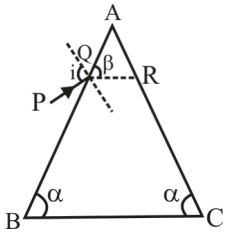
422. A ray of light which is incident in air on the surface of glass block is deviated through 15°. The angle of incidence in air is 60°. What is the angle of refraction in glass ? Also, calculate the critical angle for a glass-air interface.

ISC-2005

423. Obtain the expression for the angle of incidence of a ray of light which is incident on the face of a prism of refracting angle A so that it suffers total internal reflection at the other face. (Given the refractive index of the glass of the prism is μ).

CBSE-2019

424. A ray of light incident on the face AB of an isosceles triangular prism makes an angle of incidence (i) and deviates by angle β as shown in the figure. Show that in the position of minimum deviation $\angle\beta = \angle\alpha$. Also find out the condition when the refracted ray QR suffers total internal reflection.

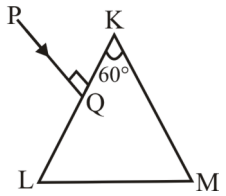


CBSE-2019

425. Under what conditions does the phenomenon of total internal reflection take place ? Draw a ray diagram showing how a ray of light deviates by 90° after passing through a right-angled isosceles prism.

CBSE-2019

426. A triangular prism of refracting angle 60° is made of a transparent material of refractive index $2/\sqrt{3}$. A ray of light is incident normally on the face KL as shown in the figure. Trace the path of the ray as it passes through the prism and calculate the angle of emergence and angle of deviation.



CBSE-2019

427. (i) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (μ) in terms of angle of prism (A) and angle of minimum deviation (δ_m).

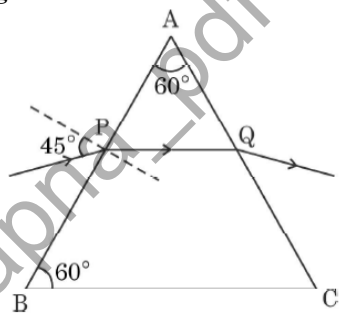
(ii) The radii of curvature of the two surfaces of a concave lens are 20 cm each. Find the refractive index of the material of the lens if its power is –5·0 D.

CBSE-2023

428. A ray of light is refracted by a glass prism. Obtain an expression for the refractive index of the glass in terms of the angle of prism A and the angle of minimum deviation δm.

CBSE-2023

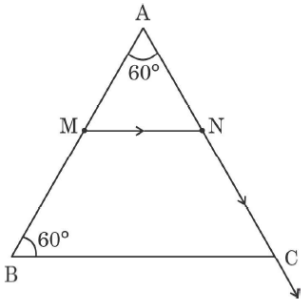
429. A ray of light is incident on a prism at an angle of 45° and passes symmetrically as shown in the figure. Calculate :



(a) the angle of minimum deviation,
(b) the refractive index of the material of the prism, and
(c) the angle of refraction at the point P.

CBSE-2022

430. A ray is incident on a prism of material of refractive index $\sqrt{2}$ at point M such that it grazes along NC after emerging from the prism, as shown in the figure.



Find :
(a) the critical angle for the prism.
(b) the angle of refraction at face AB.

CBSE-2022

431. The refractive index of an equilateral triangular prism kept in air is $\sqrt{2}$. Calculate :
(a) the angle of minimum deviation.
(b) the critical angle for the prism.

CBSE-2022

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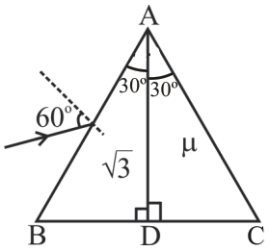
432. Draw the ray diagram to show use of total internal reflection in
(i) optical fiber, and
(ii) a prism that bends the ray by 90°

CBSE-2020

433. A composite prism ABC is made up of two identical right-angled prisms ABD and ADC made up of different materials of refractive indices $\sqrt{3}$ and μ respectively. A ray of light is incident on face AB of this prism at 60° as shown in the figure. It is observed that the final emergent ray grazes along face AC. Find the value of μ.



OR

CBSE-2020

434. A point object is kept on the principal axis of a convex spherical surface of radius of curvature R, separating a medium of refractive index μ_2 from a medium of refractive index μ_1 (in which the object is kept). A real image of the object is formed by this surface. Draw the ray diagram to show the image formation and derive the relation between the object distance and image distance and image distance in terms of μ_1, μ_2 and R.

CBSE-2020

435. Find the value of angle of minimum deviation of a prism. $\left[\text{Given } \mu = \sqrt{2}, A = 60^\circ\right]$.

Assam Board-2014

436. Establish the following relation for total deviation δ of a ray of light refracted through a triangular glass prism.

$$\delta = i + e - A$$

where *i* is the angle of incidence, e is the angle of emergence and A is the angle of the prism.

Assam Board-2013

437. You are given a prism in which the two refracting surfaces are at 90° with each other. Draw ray diagrams using this prism so that *(i)* the image of an object is rotated by 90° and *(ii)* the image of the object is rotated by 180°.

Assam Board-2017

438. A ray of light suffers minimum deviation while passing through a prism of refractive index 1.5 and refracting angle 60°. Calculate -(a) the angle of deviation and (b) the angle of incidence.

Meghalaya Board-2021, 2023

439. Show that in case of a prism A + D = i + e where symbols have their usual meanings.

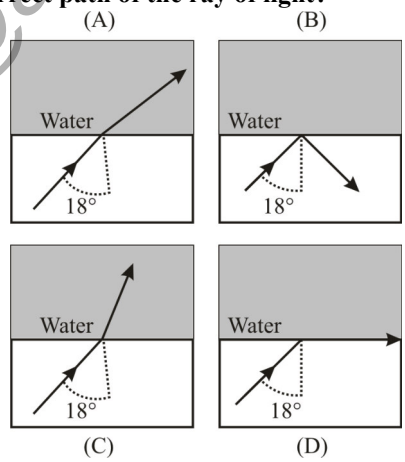
J&K Board-2021

440. The angle of a prism is 60°. If the minimum angle of deviation of a ray through it is 30°, find the refractive index of the material of the prism.

Section-D (Case-Based Questions)

441. A ray of light travels from a denser to a rarer medium. After refraction, it bends away from the normal. When we keep increasing the angle of incidence, the angle of refraction also increases till the refracted ray grazes along the interface of two media. The angle of incidence for which it happens is called critical angle. If the angle of incidence is increased further the ray will not emerge and it will be reflected back in the denser medium. This phenomenon is called total internal reflection of light.

(i) A ray of light travels from a medium into water at an angle of incidence of 18°. The refractive index of the medium is more than that of water and the critical angle for the interface between the two media is 20°. Which one of the following figures best represents the correct path of the ray of light?



(ii) A point source of light is placed at the bottom of a tank filled with water, of refractive index μ, to a depth d. The area of the surface of water through which light from the source can emerge, is :

(a) $\frac{\pi d^2}{2(\mu^2 - 1)}$ **(b) $\frac{\pi d^2}{(\mu^2 - 1)}$**

(c) $\frac{\pi d^2}{\sqrt{2}\sqrt{(\mu^2 - 1)}}$ **(d) $\frac{2\pi d^2}{(\mu^2 - 1)}$**

(iii) For which of the following media, with respect to air, the value of critical angle is maximum ?

(a) Crown glass **(b) Flint glass**
(c) Water **(d) Diamond**

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(iv) The critical angle for a pair of two media A and B of refractive indices 2.0 and 1.0 respectively is :

(a) 0° (b) 30°

(c) 45° (d) 60°

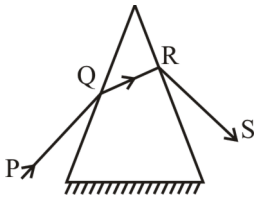
(v) The critical angle of pair of a medium and air is 30°. The speed of light in the medium is :

(a) 1×10^8 ms^{-1} (b) 1.5×10^8 ms^{-1}

(c) 2.2×10^8 ms^{-1} (d) 2.8×10^8 ms^{-1}

CBSE-2022

442. (a)An equilateral glass prism is placed on a horizontal surface. A ray PQ is incident on it. For minimum deviation:



(i) PQ is horizontal

(ii) QR is horizontal

(iii) RS is horizontal

(iv) None of these

(b) A thick lens gives coloured images due to _____

(c) In a compound micro scope the nature of the intermediate image is ___

(d) Based on refraction and total internal reflection explain the formation of rainbow.

Kerala Board-2013

Section-E (Long Answer)

443. Draw the ray diagram showing refraction of ray of light through a glass prism. Derive the expression for the refractive index μ of the material of prism in terms of the angle of prism A and angle of minimum deviation δ_m.

CBSE-2020

444. Draw a ray diagram of light passing throught a triangular glass prism. If prism angle is A then deduce the relation $\mu = \dfrac{\sin\left(\dfrac{A+\delta m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$ (where μ = refractive index of substance of prism and δm = minimum deviation).

Assam Board-2023

Rajasthan Board-2023

Bihar Board-2022

Jharkhand Board-2019

Meghalaya Board-2013, 2017

Kerala Board-2017

445. Define angle of minimum deviation. Obtain an expression for the refractive index of the material of the prism angle of minimum deviation.

Nagaland Board-2017, 2021

446. Derive an equation $\delta = i + e - A$ for an equilateral prism and using it obtain an equation for refractive index (n) of material of prism. 4

Gujarat Board- March, 2019

447. Establish the expression for finding the refractive index of material of a prism.

MP Board-2012

448. Define dispersion without deviation. Derive an expression for its essential condition and resultant dispersion.

MP Board-2015

449. Draw the ray diagram showing refraction of monochromatic light through a glass prism of refraction angle A. Hence derive formula for refractive index μ of glass prism in terms of angle of prism and angle of minimum deviation. Also draw i-δ curve of prism.

Chhattisgarh Board-2019

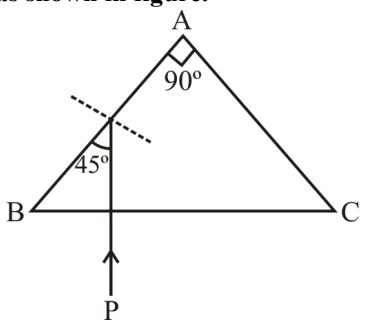
450. Drawing a neat labelled diagram, show the refraction of a ray of light passing, through a prism of equiangular triangle base. How does the value of angle of deviation change as we increase the value of angle of incidence? Draw the corresponding graph. If deviation is minimum for an angle of incidence of 45°, calculate the value of (i) angle of minimum deviation (ii) refractive index of the material of the prism.

NIOS-2017

451. (ii) A ray of light is incident at an angle of 60° on one face of a prism with the prism angle A = 60°. The ray passes symmetrically through the prism. Find the angle of minimum deviation (δ_m) and refractive index of the material of the prism. If the prism is immersed in water, how will δ_m be affected ? Justify your answer.

CBSE-2023

452. (b) A ray of light PQ enters an isosceles right angled prism ABC of refractive index 1.5 as shown in figure.



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(i) Trace the path of the ray through the prism.
(ii) What will be the effect on the path of the ray if the refractive index of the prism is 1.4?

CBSE-2020

453. The refractive index of glass in the form of a prism is unknown. For an incident ray of light the angle of minimum deviation is found to be 40°. Calculate the refractive index of the material of the prism if the angle of prism is measured to be 60°.

Assam Board-2023

454. Draw a diagram showing a ray of light passing through a triangular glass prism. Derive an expression for the refractive index of the material of the prism.

Kerala Board-2021

455. Obtain an expression for the refractive index of the material of the prism in terms of the angle of the prism and the angle of minimum deviation.

Meghalaya Board-2021

456. With the help of a diagram, obtain an expression for the refractive index of the material of the prism.
If θ is the angle of incidence and the refracted ray inside the prism is parallel to the base, then what will be the angle of emergence?

Goa Board-2023

457. Obtain an expression for the refractive index of the material of a prism in terms of angle of prism of prism and the angle of minimum deviation.
Draw necessary ray diagram.
If rays of red and blue light are incident on the given prism, then which ray will have the larger value of angle of minimum deviation ?

Goa Board-2019

458. Derive the expression for refractive index of the material of the prism in terms of angle of the prism and angle of minimum deviation.

Karnataka Board-March, 2015

459. A prism of angle of minium deviation of 40°. What is its refractive index? Calculation the angle of incidence.

Karnataka Board-July, 2014

460. Refractive index of equilateral prism is 1.532. Calculate the angle of minimum deviation when it is immersed in water of refractive index 1.33.

Karnataka Board-July, 2020

461. What is dispersive power? Find the necessary conditions for obtaining deviation, without dispersion by two thin prisms

Bihar Board-2019

VI. Optical Instrument and Human Eye

Section-A (Multiple Choice Questions)

462. In the primary rainbow, light is refracted twice and internally reflected once.

Rajasthan Board-2023

463. The numerical aperture of objective of a microscope is 0.12. The limit of resolution, when light of wavelength 6000 Å is used to view an object is
(a) 0.25×10^{-7}m (b) 2.5×10^{-7}m
(c) 25×10^{-7}m (d) 250×10^{-7}m

Maharashtra Board-2015

Ans. (c) :

464. A person cannot see objects clearly beyond 2.0 m. The power of lens required to correct his vision will be
(a) + 2.0 D (b) – 1.0 D
(c) + 1.0 D (d) – 0.5 D

Nagaland Board-2017

Ans. (d) :

465. For what distance is ray optics a good approximation when the aperture is 3 mm wide and the wavelength is 500 mm?
(a) 18 m (b) 1.8 m
(c) 18 cm (d) 1.8 m

Gujarat Board- August, 2020

Ans. (a) :

466. Assume that a light of wave length 6000 Å is coming from a star. What is the limit of resolution of a telescope whose objective has a diameter of 254 cm?
(a) 2.9×10^{7} radian (b) 2.9×10^{6} radian
(c) 2.9×10^{-6} radian (d) 2.9×10^{-7} radian

Gujarat Board- August, 2020

Ans. (d) :

467. _____is used for Lasik eye surgency.
(a) Ultra violet rays (b) Micro waves
(c) Infared rays (d) Radio waves

Gujarat Board- August, 2020

Ans. (a) :

468. A defect of vision in which lines in one plane of an object appear in focus while those in another plane are out of focus is called_____
(a) distortion (b) astigmatism
(c) myopia (d) hypermetropia

Gujarat Board- March, 2019

Ans. (b) :

469. The ratio of resolving power of telescope, when lights of wavelengths 5000 Å and 4000 Å are used, is.....

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(a) 5 : 4 (b) 16 : 25
(c) 4 : 5 (d) 9 : 1

Gujarat Board- March, 2019

Ans. (c) :

470. Detailed information can be obtained by the Oil Immersion objective of a microscope because the objective has.....
(a) greater value of resolution
(b) large value of magnification
(c) large diameter
(d) smaller value of resolution

Gujarat Board- March, 2019

Ans. (b) :

471. The focal length of objective lens and eyepiece is f_0 and f_e respectively. Magnifying power of the telescope = ____.
(a) $\frac{f_0}{f_e}$ (b) $f_0 - f_e$
(c) $f_0 + f_e$ (d) $\frac{f_e}{f_0}$

Gujarat Board-March, 2022

Ans. (a) :

472. The focal length of objectives is 100 cm and the focal length of an eycpiece is 1 cm, then the tube length of the telescope is _____cm.
(a) 100 (b) 101
(c) 99 (d) 1000

Gujarat Board- July, 2022

Ans. (b) :

473. The image formed by a simple microscope is
(a) imaginary and erect
(b) imaginary and inverted
(c) red and crect
(d) real and inverted

Jharkhand Board-2023

Ans. (a) :

474. If the focal length of objective lens of an astronomical telescope is 20 cm and the length of it is 25 cm, the magnification of the telescope for normal adjustment is :
(a) 5 (b) 4
(c) 1.25 (d) 1

Jharkhand Board-2020

Ans. (c) :

475. In an astronomical telescope focal lengths of the two lenses are 0.3 m and 0.05 m. In normal adjustment the distance between them is
(a) 0.25 m (b) 0.175 m
(c) 0.35 m (d) 0.15 m

Jharkhand Board-2019

Ans. (c) :

476. The focal length of eye in compound microscope.....the focal length of the objective.
(a) is less than (b) is more than
(c) is equal (d) None of these

MP Board-2022

Ans. (b) :

477. The focal length of eye piece in telescope _____ the focal length of the objective.
(a) is less than (b) is more than
(c) is equal (d) none of these

MP Board-2023

Ans. (a) :

478. Objective in a reflection telescope is
(a) convex mirror (b) concave mirror
(c) plane mirror (d) prism

UP Board-2021

Ans. () :

479. The focal length of the objective of a compound microscope is.
(a) greater than the focal length of eyepiece.
(b) lesser than the focal length of eyepiece.
(c) equal to the focal length of eyepiece.
(d) equal to the length of its tube.

CBSE-2020

Ans. (b) :

480. Larger aperture of objective lens in an astronomical telescope
(a) increases the resolving power of telescope.
(b) decreases the brightness of the image.
(c) increases the brightness of the image.
(d) decreases the length of the telescope

CBSE-2020

Ans. (a) :

481. The electromagnetic waves used in LASIK eye surgery is
(a) micro waves
(b) ultraviolet rays
(c) infra-red waves
(d) gamma rays

Kerala Board-2021

Ans. (b) :

482. The magnifying power of an astronomical telescope for normal adjustment is.
(a) $-\frac{f_0}{f_e}$ (b) $-f_o \times f_e$
(c) $-\frac{f_e}{f_o}$ (d) $-f_o \times f_e$

Bihar Board-2019

Ans. (a) :

483. The length of tube in normal adjustment of Astronomical telescope is
(a) $f_o + f_e$ (b) $f_o - f_e$
(c) $f_e - f_o$ (d) $f_o \times f_e$

Bihar Board-2021

Ans. (a) :

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484. The image formed by the objective of compound microscope is
(a) Virtual and diminished
(b) Real and diminished
(c) Virtual and enlarged
(d) Real and enlarged

Bihar Board-2021

Ans. (d) :

485. On increasing the length of the tube of compound microscope, magnifying power
(a) increases (b) decreases
(c) does not change (d) becomes zero

Bihar Board-2022

Ans. (b) :

486. The final image formed by a terrestrial telescope is
(a) virtual and inverted compared to the object
(b) virtual and erect compared to the object
(c) real and erect compared to the object
(d) none of these

Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

487. Draw a ray diagram to make someone understand how a virtual and many times magnified image of an object is formed in a compound microscope.

Assam Board-2023

488. The diameter of objective lens of Telescope is 1 meter. Calculate its resolving power for the light of wavelength 4538 Å.

MP Board-2022

489. Why electron is preferred over X - ray in microscope?

Tamil Nadu Board-2023

490. Mention a method to increase the resolving power of microscope.

Karnataka Board-March, 2020

491. How the eye of a person suffering from myopia can be corrected? Explain with the help of ray diagram.

Punjab Board-2018

492. Draw a labelled diagram showing course of rays for a simple microscope

J&K Board-2016

493. Define Magnifying power and resolving power of a telescope.
(Objective Type Questions)

J&K Board-2014, 2015

494. Obtain an expression for magnifying power of simple microscope?

J&K Board-2012

495. Finde the magnifying power and length of astronomical telescope of objective and eye piece of focal length 144 cm and 6 cm respectively .

J&K Board-2022

496. Formula for magnifying power of compound microscope is…..

MP Board-2020

497. Write any two difference between refractive telescope and refractive reflective telescope.

MP Board-2023

498. An astronomical telescope consists of two thin convex lenses. A and B, placed 36 cm apart and has a magnifying power 8, in normal adjustment. What will be the focal lengths, f and f ', of the two lenses, of the telescope.

NIOS-2016

499. Explain the meaning of power of accommodation of human eye.

UP Board-2017

500. Draw a ray diagram of image formation by a myopic eye.

UP Board-2021

501. The magnifying power of a telescope is 9. When it is adjusted for parallel rays then distance between eye lens and objective is 20 cm. Determine the focal lengths of both the lenses.

UP Board-2023

502. What is meant by short sightedness ?

ISC-2016, 2014

503. What type of lens is used to correct long sightedness?

ISC-2013, 2015

504. State anyone advantage of using a reflecting telescope in place of a refracting telescope.

ISC-2015

505. State how the resolving power of an astronomical telescope can be increased.

ISC-2010

506. Why all over the world, giant telescopes are of reflecting type ? State any one reason.

ISC-2009

507. Draw ray diagram to illustrate the formation of image at infinity in a refracting telescope.

ISC-2003

508 . An astronomical telescope set for normal adjustment has a magnifying power 10. If the focal length of the objective is 1.20 m, what is the focal length of the eyepiece ?

ISC-2001

509. With regard to an astronomical telescope of refraction type, state how you will increase its
(i) magnifying power
(ii) resolving power

ISC-2014

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510. An astronomical telescope uses two lenses of powers 10 D and 1 D. If the final image of a distant object is formed at infinity, calculate the length of the telescope.

ISC-2014

511. (i) Define resolving power of a simple astronomical telescope.

(ii) State one advantage of a reflecting telescope over refracting telescope.

ISC-2012

512. An astronomical telescope consists of two thin convex lenses having focal lengths of 140 cm and 5 cm. The telescope is adjusted to be in normal adjustment.

(i) What is the angular magnification, i.e. magnifying power of the telescope in this set up ?

(ii) What is the distance between the two lenses equal to ?

ISC-2011

513. An astronomical telescope consists of two convex lenses having focal lengths 80 cm and 4 cm. When it is normal adjustment, what is its

(i) length ?

(ii) magnifying power ?

ISC-2009

505. A simple microscope or a magnifying glass with a focal length 5 cm forms an image at the near point of the eye. Find its magnification.

ISC-2006

514. Define the angular magnification of an optical instrument.

ISC-2004

515. What are the two possible values of the magnifying powers of a simple microscope made of convex lens of focal length f = 5.0 cm.

ISC-2003

516. A convex lens of a focal length 5 cm is used as a simple microscope. Where should an object be placed so that the image formed by it lies at the least distance of distinct vision (D = 25 cm) ?

ISC-2015

517. Explain the statement : " Angular magnification of a compound microscope in normal use is 30".

ISC-2010

518. (i) Define the magnifying power of a microscope in terms of visual angles.

(ii) What is the advantage of a compound microscope over a simple microscope ?

ISC-2004

519. Draw a schematic ray diagram of a compound microscope with the final image formed at infinity.

ISC-2000

520. State the condition under which a large magnification can be achieved in an astronomical telescope.

CBSE-2019

521. Out of the two optical instruments, a microscope and a telescope, which one plays the role in magnifying the objects and in resolving the two objects kept close to each other? Explain, giving example.

CBSE-2019

522. Explain giving reason, how the resolving power of a compound microscope depends on the

(a) frequency of the incident light

(b) focal length of the objective lens.

CBSE-2019

523. Why is a reflecting telescope preferred over a refracting telescope ? Justify your answer giving two reasons.

CBSE-2023

524. An optical instrument uses of 100 D for the objective lens and 50 D for its eye piece. When the tube length is kept at 20 cm, the final image is formed at infinity.

(a) Identify the optical instrument.

(b) Calculate the magnification produced by the instrument.

CBSE-2020

525. An astronomical telescope may be a refracting type or a reflecting type. Which of the two produces image of better quality ? Justify your answer.

CBSE-2020

526. How is the resolving power of a compound microscope affected if (a) wavelength of light used is decreased, and (b) the diameter of its objective lens is increased ? Justify your answers.

CBSE-2020

527. The resolving power of a compound microscope can be _____ by using a medium (oil) of higher refractive index than air between the object and the objective lens.

CBSE-2020

528. A compound microscope is used because a realistic simple microscope does not have ____ magnification.

CBSE-2020

529. For a higher resolving power of a compound microscope, the wavelength of light used should be _____ .

CBSE-2020

530. Explain with the help of a suitable diagram, the phenomenon of which an optical fibre works. Mention any two uses of optical fibres.

CBSE-2020

531. What step can be taken to achieve high resolving power of a telescope?

Assam Board-2013

532. What is astigmatism? How it can be removed?

Assam Board-2016

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533. Define the magnifying power of a compound microscope. Why should both the objective and the eyepiece have small focal lengths in a microscope?

CBSE Delhi-2010C

534. Define the resolving power of a telescope. Write any two advantages of a reflecting telescope over a refracting telescope.

CBSE Delhi-2010C

535. How do you determine the resolving power of your eye?

Telangana Board-2018

536. What is hypermetropia? How can it be corrected?

Telangana Board-2018

537. Draw the ray diagram of image formation in case of compound microscope.

Karnataka Board-March, 2015

538. Name the type of lens which used to correct.
i) Myopia
ii) Hypermetropia

Karnataka Board-March, 2017
Karnataka Board-July, 2014

539. What is myopia? How to correct it?

Karnataka Board-March, 2016
Karnataka Board-July, 2018
Telangana Board-2015

540. How can the resolving power of a telescope be increased?

Karnataka Board-March, 2016

541. What is the nature of the lens used to rectify Myopia?

Karnataka Board-July, 2015

542. How do you determine the resolving power of your eye?

AP Board-2023

543. What do you mean by optical path ?

Bihar Board-2021

544. Under what condition will be magnifying power of a microscope be maximum ?

Bihar Board-2023

Section-C (Short Answer)

545. A small telescope has an objective lens of focal length 140 cm and eyepiece of focal length 50 cm. What is the magnifying power of telescope when image is at infinity and image is formed at least distance of distinct vision ?

Nagaland Board-2020

546. Draw a ray diagram of a reflecting type telescope. State two advantages of this telescope over a refracting telescope

CBSE Delhi-2014C

547. Two convex lenses of same focal length but of apertures A_1 and A_2 ($A_2 < A_1$), are used as the objective lenses in two astronomical telescopes having identical eyepieces. What is the ratio of their resolving power? Which telescope will you prefer and why? Give reason.

CBSE Delhi-2011

548. What is the difference in the construction of an astronomical telescope and a compound microscope ? The focal lengths of the objective and eyepiece of a compound microscope are 1.25 cm and 5.0 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 when the final image is formed at the near point.

CBSE-2020

549. Explain with the help of a suitable diagram, the phenomenon on which an optical fibre works. Mention any two uses of optical fibres.

CBSE-2023
CBSE-2022

550. Draw the ray diagram of an astronomical telescope showing image formation in the normal adjustment position. Write the expression for its magnifying power.

OR

Draw a labelled ray diagram to show image formation by a compound microscope and write the expression for its resolving power.

CBSE-2019

551. Describe the astronomical telescope on the basis of the following points :
(i) Labelled Ray diagram.
(ii) Derivation of formula for magnifying power, when final image is formed at the least distance of distinct vision.

MP Board-2015

552. Describe the compound microscope on the following headings :
(i) Labelled ray diagram of formation of image.
(ii) Magnifying power when final image is formed at least distance of distinct vision.

MP Board-2015

553. The magnifying power of a telescope depends on the focal length of the objective and that of the eye – piece.
(a) Data of some lenses are given in the table.

Lenses	Power	Aperature
L_1	6D	1 cm
L_2	3D	8 cm
L_3	10D	1 cm

Choose any two lenses which are to be preferred as objective and eye-piece to construct a telescope. Give reason for your selection.
(b) A telescope has an objective of focal length 1.44 m and an eye-piece of focal length 0.06 m. What is the separation between the objective and the eye-piece?

Kerala Board-2016

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554. Draw a labelled diagram of an astronomical telescope and explain its working. Give an expression for its magnifying power.
Nagaland Board-2018

555. Draw the ray diagram of an astronomical telescope and define its magnification.
Haryana Board-2017

556. Describe terrestrial telescope on the basis of the following points:
(i) A clear labelled diagram:
(ii) Expression for magnifying power when the final image is at least _____ of distinct vision D.
MP Board-2013

557. If length of astronomical telescope is 80 cm and its magnification is 15, then find focal length of objective lens and eyepiece.
MP Board-2013

558. Describe the compound microscope on the following headings:
(i) Labelled Ray diagram of formation of image
(ii) magnifying power when final image is formed at least distance of distinct vision.
MP Board-2014, 2015

559. Deduce the expression for magnifying power of terrestrial telescope, when final image is formed at least distance of distinct vision.
MP Board-2017

560. Draw a labelled ray diagram of Galilean telescope and derive the expression for magnifying power, when the final image is formed at least distance of distinct vision D. What will be the length of the telescope tube in this case?
MP Board-2018

561. Draw the labelled diagram of compound microscope and establish an expression for the magnifying power of a compound microscope when the image is formed at :
(i) infinity vision
(ii) least distance of distinct vision.
MP Board-2019, 2020

562. Write differences between Simple Microscope and Astronomical Telescope. (any three)
MP Board-2022

563. Draw a labelled diagram depicting the formation of image by an Astronomical Telescope in normal adjustment (when final image is formed at infinity).
Chhattisgarh Board-2019

564. Describe the compound microscope under the following points :
(i) Ray diagram of the formation of image
(ii) Derivation of formula for magnifying power when image is formed at least distance of distinct vision.
(OR)
Describe the terrestrial telescope under the following points :
(i) Ray diagram of the formation of image
(ii) Derivation of formula for magnifying power when the image is formed at least distance of distinct vision
Chhattisgarh Board-2018

565. Explain the following terms :
(a) Limit of resolution of a telescope
(b) Resolving power of a microscope
How can the resolving power of (i) a telescope and (ii) a microscope be increased?
NIOS-2012

566. With the help of a ray diagram, explain the construction and working of a compound microscope. Write the expression for its magnifying power in normal adjustment.
NIOS-2013

567. Define the following terms :
(a) Near point of an eye
(b) Angular magnification of a simple microscope
(c) Magnifying power of a microscope
(d) Resolving power of a telescope
NIOS-2014

568. Draw a neat, labelled ray diagram, showing formation of image of an object by a compound microscope. Write an expression for its magnifying power.
NIOS-2016

569. You have been given four convex lenses of focal length 35 cm, 25 cm, 8 cm and 4 cm. Which two convex lenses will you select for designing a compound microscope for maximum magnifying power and why?
NIOS-2016

570. Draw a ray diagram of a refracting telescope when final images is formed at the least distance of the distinct vision. Write the formula of its magnifying power for this position.
UP Board-2020

571. A compound microscope has an objective lens of focal length 2.0 cm and an eyepiece Jens of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at the least distance of distinct vision (25 cm) ? What is the magnifying power of the microscope?
UP Board-2020

572. Draw a neat ray diagram of compound microscope to explain the image formation.
UP Board-2022

573. (i) What is meant by resolving power of a telescope ?
(ii) State any method of increasing the resolving power of an astronomical telescope.
ISC-2017

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574. Draw a labelled ray diagram showing the formation of an image by a refracting telescope when the final image lies at infinity.

ISC-2015

575. An astronomical telescope is adjusted to form the final image at infinity. The separations between the lenses is 80 cm. The angular magnification is 15. Calculate the focal lengths of the objective lens and the eyepiece.

ISC-2007

576. (i) Draw a ray diagram to show how the image of a distant object is formed by a refracting astronomical telescope, when in normal use.

(ii) State one advantage of a reflecting astronomical telescope over a refracting astronomical telescope.

ISC-2006, 2008

577. Define magnifying power of an optical instrument. An astronomical refracting telescope consists of two lenses of focal lengths 75 cm and 5 cm. Calculate the magnifying power of the telescope, when the final image is formed at a distance of 25 cm from the eye.

ISC-2005

578. A compound microscope consists of two convex lenses of focal lengths 2 cm and 5 cm. When an object is kept at a distance of 2.1 cm from the objective, a virtual and magnified image is formed 25 cm from the eyepiece. Calculate the magnifying power of the microscope.

ISC-2012, 2016

579. Draw a labelled diagram of an image formed by a compound microscope with image at least distance of a distinct vision.

ISC-2013, 2011, 2015

580. A convex lens of focal length 5 cm is to be used as a simple microscope. Where should an object be kept, so that image formed by the lens lies at least distance D of distinct vision (D = 25 cm) ? Also, calculate the magnifying power of this instrument in this set-up.

ISC-2009

581. In a compound microscope, it consists of two convex lenses of focal length 1.5 cm and 10 cm, the object is 2 cm from the objective and the final image is formed at least distance of distinct vision (D = 25 cm). Find the distance of separation of the two lenses.

ISC-2008

582. With the help of a ray diagram, obtain the expression for the magnifying power of a simple microscope, when the image is formed at the least distance of distinct vision.

ISC-2007

583. Draw neat ray diagram of a simple microscope. Deduce the formula for angular magnification, when the image is formed at the least distance of distinct vision.

ISC-2002

584. Derive the formula for angular magnification of a compound microscope, when the final image is formed at the least distance of distinct vision. Draw the required ray diagram.

ISC-2015

585. Draw a ray diagram to show the image formation of a distant object by a refracting telescope. Write the expression for its angular magnification in terms of the focal lengths of the lenses used. State the important considerations required to achieve large resolution and their consequent limitations.

CBSE-2019

586. Draw a labelled ray diagram of an astronomical telescope in the near point adjustment position.

A giant refracting telescope at an observatory has an objective lens of focal length 15 m and an eyepiece of focal length 1.0 cm. If this telescope is used to view the Moon, find the diameter of the image of the Moon formed by the objective lens. The diameter of the Moon is 3.48×10^8 m. and the radius of lunar orbit is 3.8×10^8 m.

CBSE-2019

587. (a) (i) Draw a ray diagram to show the working of a compound microscope. Obtain the expression for the total magnification for the final image to be formed at the near point.

(ii) In a compound microscope an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye-piece has a focal length of 5 cm and the final image is formed at the near point, find the magnifying power of the microscope.

CBSE-2023

588. (b) (i) Draw a ray diagram for the formation of image of an object by an astronomical telescope, in normal adjustment. Obtain the expression for its magnifying power.

(ii) The magnifying power of an astronomical telescope in normal adjustment is 2.9 and the objective and the eyepiece are separated by a distance of 150 cm. Find the focal lengths of the two lenses.

CBSE-2022, 2023

589. Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope.

CBSE-2013, 2023

590. The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.

CBSE-2023

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591. (a) Draw a ray diagram to show the formation of an image at the least distance of distinct vision, by a compound microscope. Hence, obtain an expression for its angular magnification.

CBSE-2022

592. (a) (i) Draw a labelled ray diagram showing the formation of the image at infinity by an astronomical telescope.

(ii) A telescope consists of an objective of focal length 150 cm and an eyepiece of focal length 6·0 cm. If the final image is formed at infinity, then calculate :

(I) the length of the tube in this adjustment, and

(II) the magnification produced.

OR

(b) (i) Draw a labelled ray diagram showing the formation of the image at least distance of distinct vision by a compound microscope.

(ii) A small object is placed at a distance of 3·0 cm from a magnifier of focal length 4·0 cm. Find :

(I) the position of the image formed, and

(II) the linear magnification produced.

CBSE-2022

593. An optical instrument uses an objective lens of power 100 D and an eyepiece of power 40 D. The final image is formed at infinity when the tube length of the instrument is kept at 20 cm.

(a) Identify the optical instrument.

(b) Calculate the angular magnification produced by the instrument.

CBSE-2020

594. An optical instrument uses a lens of power 100 D for objective lens and 50 D for its eyepiece. When the tube length is kept at 25 cm. The final image is formed at infinity.

(a) Identify the optical instrument

(b) Calculate the magnification produced by the instrument.

CBSE-2020

595. (a) Draw the ray diagram of an astronomical telescope when the final image is formed at infinity. Write the expression for the resolving power of the telescope.

(b) An astronomical telescope has an objective lens of focal length 20 m and eyepiece of focal length 1cm.

(i) Find the angular magnification of the telescope.

(ii) If this telescope is used to view the Moon, find the diameter of the image formed by the objective lens. Given the diameter of the Moon is 3.5×10^6 m and radius of lunar orbit is 3.8×10^8m.

CBSE-2020

596. The objective lens and eye piece lens of a Compound microscope have focal lengths 1.5cm and 5cm respectively. The object is placed at a distance 1.8cm. What is its magnification?

Assam Board-2016

597. (d)Draw the ray diagram for the formation of image by a compound microscope. What is its magnification?

Assam Board-2016

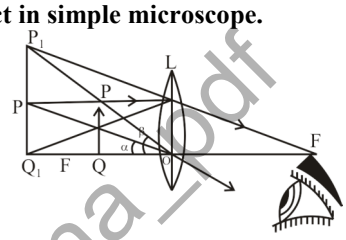
598. Draw a ray diagram for the formation of an image by a reflecting telescope.

Assam Board-2015

599. Draw a ray diagram to show the formation of final image at least distance of distinct vision by a compound microscope.

Assam Board-2015

600. The figure shows the image formation of an object in simple microscope.



(a) Find out the object distance and image distance from the figure.

(b) Derive an equation for magnifying power of the simple microscope.

Kerala Board-2020

601. Draw a ray diagram showing the image formation in a refracting telescope when the final image is formed at infinity. Write an equation for the length of the telescope tube in terms of focal length of the objective and eyepiece.

Kerala Board-2021

602. Derive an expression for the magnifying power of an astronomical telescope in normal adjustment.

Meghalaya Board-2018

603. Find the magnifying power of an astronomical telescope for normal adjustment if the focal lengths of its objective and eyepiece are 50 cm and 10 cm respectively.

Meghalaya Board-2014

604. The objective of an astronomical telescope has a diameter of 150 mm and a focal length of 4.00m. The eyepiece has a focal length of 25.00mm. Calculate the magnifying and resolving power of telescope. (λ=6000 Å for yellow colour).

CBSE Delhi-2011C

605. (i) Draw a neat labelled ray diagram of an astronomical telescope in normal adjustment. Explain briefly it working.

(ii) An astronomical telescope uses two lenses of power 10D and 1D. What is its magnifying power in normal adjustment?

CBSE All India-2010

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606. (i) Draw a neat labelled ray diagram of a compound microscope. Explain briefly its working.
(ii) Why must both the objective and the eyepiece of a compound microscope have short focal lengths?

CBSE All India-2010

607. Draw a schematic diagram of a reflecting telescope (Cassegrain). Write two important advantages that te reflecting telescope has over a refracting type.

CBSE Foreign-2010

608. Explain with the help of a ray diagram, the working of an astronomical telescope. The magnifying power of a telescope in its normal adjustment is 20. If the length of the telescope is 105 cm in this adjustment, find the focal lengths of the two lenses.

CBSE All India-2010 C

609. Draw a ray diagram showing the image formation by a compound microscope. Hence, obtain expression for total magnification when the image is formed at the infinity.

CBSE Delhi-2013

610. A compound microscope uses an objective lens of focal length 4cm and eyepiece lens of focal length 10cm. An object is placed at 6cm from the objective lens. Calculate the magnifying power of the compound microscope. Also, calculate the length of the microscope.

CBSE All India-2011

611. Two convex lenses of focal length 20cm and 1 cm constitute a telescope. The telescope is focused on a point which is
1 m away from the objective. Calculate the magnification produced and the length of the tube if the final image is formed at a distance 25cm from the eyepiece.

CBSE Delhi-2011C

612. (i) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.
(ii) The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focused on a certain object. The distance between the objective and eyepiece is observed to be 14cm. If least distance of distinct vision is 20 cm. Calculate the focal length of the objective and the eyepiece.

CBSE Delhi-2014C

613. Which two of the following lenses L_1, L_2 and L_3 will you select as objective and eyepiece for constructing best possible (i) telescope (ii) microscope? Give reason to support your answer.

Lens	Power(P)	Aperture (A)
L_1	6D	1cm
L_2	3D	8cm
L_3	10D	1cm

CBSE Delhi-2015C

614. (i) A giant refracting telescope has an objective lens of focal length 15m. If an eyepiece of focal length 1.0 cm is used, which is the angular magnification of the telescope?
(ii) If this telescope is used to view the moon, what is the diameter of the imager of the moon formed by the objective lens? The diameter of the moon is 3.48×10^8 m and radius of lunar orbit is 3.8×10^8m.

CBSE All India-2015, 2011

615. Draw a schematic ray diagram of reflecting telescope showing how rays coming from a distant object are received at the eyepiece. Write its two important advantages over a refracting telescope.

CBSE Delhi-2016, CBSE Foreign-2013

616. (i) Draw a ray diagram depicting the formation of the image by an astronomical telescope in normal adjustment.
(b) You are given the following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope? Give reason.

Lenses	Power(D)	Aperture(cm)
L_1	3	8
L_2	6	1
L_3	10	1

CBSE All India-2017

617. Draw a labelled ray diagram of an astronomical telescope in the near point adjustment position. A giant refracting telescope at an observatory has an objective lens of focal length 15m and an eyepiece of focal length 1.0cm. If this teleshops is used to view the Moon, find the diameter of the image of the Moon formed by the objective lens. The diameter of the Moon is 3.48×10^6 m and the radius of lunar orbit is 3.8×10^8m.

CBSE Delhi-2019

618. You are given two converging lenses of focal lengths 1.25 cm and 5 cm to design to compound microscope. If it is desired to have a magnification of 30, find out the separation between the objective and the eyepiece.

CBSE All India-2015

619. A small telescope has an objective lens of focal length 150 cm and eyepiece of focal length 5cm. What is the magnifying power of the telescope for viewing distance objects in normal adjustments.
If this telescope is used to view a 100m tall tower 3km a way, then what is the height of the tower formed by the objective lens.

CBSE Delhi-2015

620. Write the expression for limit of resolution of (a Microscope and b) Telescope. Write one method increasing the resolving power of microscope.

Karnataka Board-July, 2014

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621. What do you understand by resolving power of a microscope? How will resolving power of microscope be affected when:
(a) Wavelength of light used decreases
(b) Diameter of objective lens decreases

Uttarakhand Board-2019

Section-D (Case-Based Questions)

622. A compound microscope consists of two converging lenses. One of them, of smaller aperture and smaller focal length is called objective and the other of slightly larger aperture and slightly larger focal length is called eye-piece. Both the lenses are fitted in a tube with an arrangement to vary the distance between them. A tiny object is placed in front of the objective at a distance slightly greater than its focal length. The objective produces the image of the object which acts as an object for the eye-piece. The eye piece, in turn produces the final magnified image.

I. In a compound microscope the image formed by the objective and the eye-piece are respectively
(a) virtual, real (b) real, virtual
(c) virtual, virtual (d) real, real

II. The magnification due to a compound microscope does not depend upon
(A) The aperture of the objective and the eye-piece
(B) the focal length of the objective and the eye-piece
(C) the length of the tube
(D) the colour of the light used

III. Which of the following is not correct in the context of a compound microscope
(A) Both the lenses are of short focal lengths
(B) The magnifying power increases by decreasing the focal lengths of the two lenses.
(C) The distance between the two lenses is more than (fo + fe).
(D) The microscope can be used as a telescope by interchanging the two lenses.

IV. A compound microscope consists of an objective of 10X and an eye-piece of 20X. The magnification due to the microscope would be
(a) 2 (b) 10
(c) 30 (d) 200

V. The focal lengths of objective and eye-piece of a compound microscope are 1.2 cm and 3.0 cm respectively. The object is placed at a distance of 1.25 cm from the objective. If the final image is formed at infinity, the magnifying power of the microscope would be
(a) 100 (b) 150
(c) 200 (d) 250

CBSE-2022

623. Draw a labelled diagram to show the image formation at the near point due to a compound microscope and hence calculate its magnifying power.

Meghalaya Board-2014

Section-E (Long Answer)

624. Define the magnifying power of a compound microscope when the final image is formed at infinity. Why must both the objective and the eyepiece of a compound microscope has short focal lengths? Explain.

CBSE Delhi-2017

625. Draw a ray diagram for the formation of image by a compound microscope. Write the expression for total magnification when the image is formed at infinity .

CBSE Delhi-2014C

626. Draw a schematic arrangement of a reflecting telescope (Cassegrain) showing how rays coming from a distant object are received at the eyepiece. Write its two important advantages over a refracting telescope.

CBSE Delhi-2013, 2014 C

627. With the help of a ray diagram, show how a compound microscope forms a magnified image of a tiny object, at least distance of distinct vision. Hence derive an expression for the magnification produced by it.

CBSE-2022

628. (b) With the help of a ray diagram explain the working of a reflecting telescope. Mention two advantages of a reflecting telescope over a refracting telescope.

CBSE-2022

629. With the help of a labeled ray diagram, explain the construction and working of a Cassegrain reflecting telescope.
(a) An amateur astronomer wishes to estimate roughly the size of the Sun using his crude telescope consisting of an objective lens of focal length 200 cm and an eyepiece of focal length 10 cm. By adjusting the distance of the eyepiece from the objective, he obtains an image of the sun on a screen 40 cm behind the eyepiece. The diameter of the Sun's image is measured to be 6·0 cm. Estimate the Sun's size, given that the average Earth – Sun distance is $1{\cdot}5 \times 10^{11}$ m.

CBSE-2019

630. (a) Draw a labeled ray diagram of compound microscope, when final image forms at the least distance of distinct vision.
(b) Why is its objective of short focal length and of short aperture, compared to its eyepiece? Explain.
(c) The focal length of the objective is 4 cm while that of eyepiece is 10 cm. The object is placed at a distance of 6 cm from the objective lens.
(i) Calculate the magnifying power of the compound microscope, if its final image is formed at the near point.
(ii) Also calculate length of the compound microscope.

CBSE-2019

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631. What the help of ray diagram, describe the construction, working of a compound microscope when the final image is formed at least distance of distinct vision (D=25cm). Derive an expression for its magnifying power (m).

Punjab Board-2018

632. Describe an Astronomical telescope and derive an expression for its magnifying power in normal adjustment.

J&K Board-2018

633. Explain the working of a compound microscope. Obtain expression for its magnification power.

Haryana Board-2018
J&K Board-2017

634. What is meant by compound microscope? Draw a ray diagram of the formation of an image by a compound microscope. Briefly describe its working and derive the formula for its total magnification.

Rajasthan Board-2022

635. What is compound microscope ? With the help of a ray diagram, derive the expression for total magnification of a compound microscope when image is formal at infinity.

Nagaland Board-2021

636. Explain the reflective telescope with diagram and write its advantages over refractive telescope. On what factors does its resolving power depend?

Nagaland Board-2020

637. Draw a labelled ray diagram showing the formation of image in a compound microscope. Define its magnifying power and write expression for it.

Haryana Board-2018

638. A compound microscope consists of an objective lens of focal length 2.0 cm and an eye piece of focal length 6.25 cm separated by a distance 15 cm. How far from the objective should an subject be placed in order to obtain the final image at
(a) the least distance of distinct vision (25 cm) and
(b) at infinity?
What is the magnifying power of microscope in each case?

Gujarat Board-2023

639. Explain simple microscope on the basis of the following points :
(a) Ray diagram for the formation of image;
(b) Expression for magnifying power when the final image is formed :
(i) At the least distance of distinct vision;
(ii) At infinity

MP Board-2012

640. Describe labelled diagram of Terrestrial telescope and derive expression for its magnifying power.

MP Board-2012

641. Derive the expression for magnifying power of simple microscope when image is formed at least distance of distinct vision.

MP Board-2017

642. Obtain an expression for the magnifying power by drawing the ray diagram of astronomical telescope :
(i) When the final image is formed at least distance of distinct vision.
(ii) When the final image is formed at infinity.

Chhattisgarh Board-2022, 2023

643. Draw the ray diagram to show the formation of image by compound microscope and obtain an expression for the magnifying power when final image is formed at least distance of distinct vision.

Chhattisgarh Board-2020, 2021

644. Draw a ray diagram of an astronomical telescope by showing final image at the least distance of the distinct vision. The magnifying power of an astronomical telescope is 15 and distance between objective lens and eye-piece is 80 cm. If both lenses are convex, find the focal length of each lens.

UP Board-2017

645. Draw labelled ray diagram of a compound microscope when final image is formed at infinity. Least distance of distinct vision of an observer is 25cm. The focal length of objective and eye lens of the compound microscope used by him are 8×10^{-3} m and 2.5×10^{-2} m respectively. Clear image of the object is found at 9×10^{-3} m from objective. Find the distance between objective and eye lens and magnifying power of the microscope.

UP Board-2021

646. (i) Draw the ray diagram for the formation of image by a refracting telescope having the final image formed at infinity.
(ii) For refracting telescope, define the angular magnification and derive the formula for the same for image formed at infinity.

ISC-2002

647. (a) Draw a labelled ray diagram of compound microscope, when final image forms at the least distance of distinct vision.
(b) Why is its objective of short focal length and of short aperture, compared to its eyepiece? Explain.
(c) The focal length of the objective is 4 cm while that of eyepiece is 10 cm. The object is placed at a distance of 6 cm from the objective lens.
(i) Calculate the magnifying power of the compound microscope, if its final image is formed at the near point.
(ii) Also calculate length of the compound microscope.

CBSE-2019

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648. With the help of a labeled ray diagram, explain the construction and working of a Cassegrain reflecting telescope.

(a) An amateur astronomer wishes to estimate roughly the size of the Sun using his crude telescope consisting of an objective lens of focal length 200 cm and an eyepiece of focal length 10 cm. By adjusting the distance of the eyepiece from the objective, the obtains an image of the Sun on a screen 40 cm behind the eyepiece. The diameter of the Sun's image is measured to be 6.0 cm. Estimate the Sun's size, given that the average Earth-Sun distance is 1.5×10^{11} m.

CBSE-2019

649. Draw a ray diagram to show how the final image is formed at infinity in an astronomical refracting telescope. Obtain an expression for its magnifying power.

CBSE-2023

650. The focal lengths of objective and eyepiece of a telescope are 200cm and 10cm respectively. It is used to get an image of the Sun on a screen placed 40cm behind the eyepiece. The diameter of the image is 6cm. What is the diameter of the Sun? Given, the distance from earth to the Sun is 1.5×10^{11}m.

Assam Board-2017

651. What are the main considerations in the construction of an astronomical telescope and how are they achieved? Why are mirror objectives rather than lens objectives used in modern telescope? Clarify giving schematic diagram how the problem of partial obstruction of ray of light by the eyepiece and observes is overcome in the improved version of reflection telescope.

Assam Board-2017

652. With the help of a neat diagram, explain the working of a compound microscope. Obtain an expression for its magnifying power when the final image is formed at least distance of distinct vision.

Meghalaya Board-2019
Meghalaya Board-2023

653. With the help of ray diagram, explain the formation of image in compound microscope. Derive an expression for its magnifying power

Uttarakhand Board-2023
J&K Board-2021

654. Draw a ray diagram to show the working of a compound microscope. Deduce an expression for image is formed at the near point. In a compound microscope, an object is placed at a distance of 1.5cm from the objective of focal length 1.25 cm. If the eyepiece has a focal length of 5 cm and the final image is formed at the near point. Estimate the magnifying power of the microscope.

CBSE Delhi-2010

655. How is the working of a telescope different from that of a microscope?

The focal lengths of the objective and eyepiece of a microscope are 1.25 cm and 5cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 in normal adjustment.

CBSE Delhi-2012

656. Define magnifying power of a telescope. Write its expression.

A small telescope has an objective lens of focal length 150cm and an eyepiece of focal length 5cm. If this telescope is used to view a 100 m high tower 3 km away, to view a 100 , high tower 3km away, find the height of the final image when it is formed 25cm away from the eyepiece.

CBSE Delhi-2012

657. (i) Draw a labeled ray diagram to obtain the real image formed by an astronomical telescope in normal adjustment position. Define its magnifying power.

(ii) You are given three lenses of power 0.5 D, 4D and 10D to design a telescope.

(a) Which lenses should be used as objective and eyepiece? Justify your answer.

(b) Why is the aperture of the objective preferred to be large?

CBSE All India-2013

658. (i) Draw a labelled ray diagram showing the image formation of a distant object by refracting telescope.

Deduce the expression for its magnifying power when the final image is formed at infinity.

(ii) The sum of focal lengths of the two lenses of a refracting telescope is 105 cm. The focal length of one lens is 20 times that of the other.

Determine the total magnification of the telescope when the final image is formed at infinity.

CBSE All India-2014

659. In a compound microscope, the distance between the objective and the eyepiece is 12cm. The focal length of the objective is 0.6cm and the focal length of the eyepiece is 5cm. If a clear image is obtained at 25 cm on the left side of the eyepiece, then find-

(a) Initial position of the object

(b) Magnifying power of microscope.

Uttarakhand Board-2023

660. With neat diagram describe the construction and working of an astronomical telescope and find its magnifying power.

Bihar Board-2023

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10. Wave Optics

I. Wave Nature of Light, Wave Front and Huygens's Principle

Section-A (Multiple Choice Questions)

1. The nature of the wave front corresponding to extraordinary ray inside a calcite crystal is
(a) plane (b) spherical
(c) elliptical (d) cyclindrical
Tamil Nadu Board-2011

Ans. (c) :

2. Light of wavelength 6000Å is coming from a star. What is the limit of resolution of a telescope whose objective has a diameter of 100 inch?
(a) 10^{-7} radian (b) 2.9×10^{-7} radian
(c) 2.9×10^{-5} radian (d) 9.2×10^{-7} radian
Gujarat Board- March, 2020

Ans. (b) :

3. With increase in wavelength, the value of refractive index
(a) increases
(b) decreases
(c) remains unchanged
(d) none of these
Jharkhand Board-2023

Ans. (b) :

4. Huygens' wave theory of light cannot explain.
(a) Reflection of light
(b) Refraction of light
(c) Total internal reflection
(d) Photoelectric effect
Jharkhand Board-2020

Ans. (d) :

5. When light wave travels from air to glass
(a) its wavelength decreases
(b) its wavelength increases
(c) its wavelength remains unchanged
(d) its frequency decreases.
Jharkhand Board-2018

Ans. (a) :

6. According to Huygens principle, the amplitude of secondary wavelets is
(a) equal in both the forward and the backward directions.
(b) maximum in the forward direction and zero in the backward direction.
(c) large in the forward direction and small in the backward direction.
(d) small in the forward direction and large in the backward direction.
CBSE-2023

Ans. (d) :

7. A plane wavefront is incident on a concave mirror of radius of curvature R. The radius of the refracted wavefront will be :
(a) 2R (b) R
(c) $\frac{R}{2}$ (d) $\frac{R}{4}$
CBSE-2023

Ans. (c) :

8. Assertion (A) : The phase difference between any two points on a wavefront is zero.
Reason (R) : All points on a wavefront are at the same distance from the source and thus oscillate in the same phase.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.
CBSE-2023

Ans. (a) :

9. When a wave undergoes reflection at an interface from rarer to denser medium. adhoc change in its phase is:
(a) $\frac{\pi}{2}$ (b) 0
(c) π (d) $\frac{\pi}{4}$
CBSE-2020

Ans. (c) :

10. The shape of source to produce spherical wavefront is
(a) Point source
(b) Linear source
(c) Extended source at large distance
(d) Extended source at small distance
Bihar Board-2021

Ans. (a) :

11. The wavefront due to a point source at a finite distance from the source is
(a) spherical (b) cylindrical
(c) plane (d) circular
Bihar Board-2019, 2022

Ans. (a) :

12. The concept of secondary wavelets was given by
(a) Fresnel (b) Maxwell
(c) Huygens (d) Newton
Jharkhand Board-2023
Bihar Board-2023

Ans. (c) :

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Section-B (Very Short Answer)

13. Calculate the longest wavelength that can be analysed by a rock salt crystal of spacing d = 2.82 Å in the first order.
Tamil Nadu Board-2018

14. State Huygen's principle.
Tamil Nadu Board-2018

15. Define wave front and name its various types.
Karnataka Board-2014
J&K Board-2016, 2018
MP Board-2016

16. Explain the term wavefront. Describe Huygens Construction for propagation of wavefronts in a medium.
J&K Board-2012

17. Using Huygen's principle explain reflection of plane wave.
Gujarat Board- August, 2020

18. Explain Huygens' principle of secondary wavelets.
Uttarakhand Board-2022
Meghalaya Board-2021
MP Board-2012

19. Wave nature of matter is experimental proof given by……..
MP Board-2020

20. What is Huygen's wave thory?
MP Board-2021

21. What type of wavefront is generated from a line source of light ?
CBSE-2020
ISC-2017, 2008, 2004

22. State anyone postulate of Huygen's wave theory.
ISC-2011, 2003, 2001

23. Light of wavelength 4500 Å in vacuum enters into a glass block of refractive index 1.5. What is the wavelength of light in the glass block ?
ISC-2005

24. What is the shape of the wavefront diverging from a point source of light ?
ISC-2004

25. If 'd' is the distance covered by a light wave in the air in t seconds and D is the distance covered in a medium of refractive index μ in the same time, then prove that d = μD.
ISC-2006

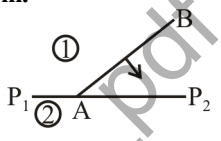
26. State Huygens' principle. How did Huygens explain the absence of the backwave ?
OR
Use Huygens' principle to show reflection/refraction of a plane wave by (i) concave mirror, and (ii) a convex lens.
CBSE-2023

27. The refractive indices of two media A and B are 2 and $\sqrt{2}$ respectively. What is the critical angle for their interface ?
CBSE-2023

28. Using Huygens' principle, draw a ray diagram showing the propagation of a plane wave refracting at a plane surface separating two media. Also verify Snell's law of refraction
CBSE-2023

29. Using Huygen's principle, for a plane wavefront incident on a plane reflecting surface, draw the reflected wavefront. Hence prove laws of reflection.
CBSE-2022

30. Define the term 'wave front of light'. A plane wave front AB propagating from denser medium (1) into a rarer medium (2) is incident on the surface P_1P_2 separating the two media as shown in fig.
Using Huygen's principle, draw the secondary wavelets and obtain the refracted wave front in the diagram.



CBSE-2020

31. The phase difference between the two points on the same wavefront is _____.
CBSE-2020

32. Define wavefront of a travelling wave. Using Huygens principle, obtain the law of refraction at a plane interface when light passes form a denser to rarer medium.
CBSE-2020

33. What is the shape of the wavefront of light emitted by a long neon bulb placed at a finite distance?
Assam Board-2015

34. Mention the shape of wave front for the portion of wave front of light from a distant star intercepted by the earth.
Kerala Board-2014

35. The phase difference between two waves meeting at a point is $3\frac{\pi}{2}$ What is the corresponding path difference?
Meghalaya Board-2015

36. Calculate the magnifying power of an astronomical telescope for normal adjustment if the focal lengths of its objective and eyepiece are 50 cm and 10 cm respectively.
OR
The phase defference between two waves meeting at a point is $\frac{3\pi}{2}$ what is the corresponding path difference?
Meghalaya Board-2023

37. Plane wavefront of light of wavelength 6000Å is incident on two slits on a screen perpendicular to the direction of light rays. If the total

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separation of 10 bright fringes on a screen 2m away is 2 cm, find the distance between the slits.

Maharashtra Board-2022

38. In a biprism experiment, light of wavelength 5200 Å is used to obtain an interference pattern on the screen. The fringe width changes by 1.3 mm when the screen is moved towards the biprism by 50 cm. Calculate the distance between the two virtual images of the slit.

Maharashtra Board-2020

Section-C (Short Answer)

39. State Huygen's principle. On the basis of wave theory prove the laws of reflection.

Tamil Nadu Board-2015

40. Use Huygen's principle to verify the laws of refraction.

Nagaland Board-2018

41. State and explain Huygen's Principle.

Gujarat Board-2023

42. What is Huygen's theory of secondary wavelets?

A monochromatic light of wavelength 6000 Å is incident on the surface of a glass having refractive index 1.5 from air. Find wavelength and speed for each of following :

(i) The refracting light

(ii) The reflecting light

UP Board-2020

43. On the basis of Huygen's wave theory, show that when light is incident on a plane mirror obliquely, angle of reflection is equal to the angle of incidence

ISC-2010, 2006

44. (a) Define a wavefront. Using Huygens' geometrical construction, explain with the help of a diagram how the plane wavefront travels from the instant t_1 to t_2 in air.

(b) A plane wavefront is incident on a convex lens. Explain, with the help of the diagram, the shape of the refracted wavefront formed.

CBSE-2019

45. Define the term wavefront. Using Huygen's wave theory, verify the law of reflection

OR

Define the term, "refractive index" of a medium. Verify Snell's law of refraction when a plane wavefront is propagating from a denser to a rarer medium.

CBSE-2019

46. Define the term "refractive index" of a medium. Verify Snell's law of refraction when a plane wavefront is propagating from a denser to a rarer medium.

CBSE-2019

47. A plane wave-front propagating in a medium of refractive index 'μ_1' is incident on a plane surface making an angle of incidence (i). It enters into a medium of refractive index μ_2 ($\mu_2 > \mu_1$). Use Huygen's construction of secondary wavelets to trace the retracted wave-front. Hence verify Snell's law of refraction.

OR

Using Huygen's construction, show how a plane wave is reflected from a surface. Hence verify the law of reflection.

CBSE-2023

48. State Hugyen's principle. With the help of a diagram, show how a plane wave is reflected from a surface. Hence verify the law of reflection.

CBSE-2023

49. A plane wavefront is incident on a surface separating two media of refractive indices n_1 and n_2 ($> n_1$). With the help of a suitable diagram, explain its propagation from the rarer to denser medium. Hence, verify Snell's law.

CBSE-2022

50. A plane wavefront is propagating from a rarer into a denser medium. Use Huygens principle to show the refracted wavefront and verify Snell's law.

CBSE-2022

51. A plane wavefront of light of wavelength 'λ' is incident normally on a narrow slit of width 'a' and a diffraction pattern is observed on a screen at a distance 'D' from the slit

(i) Depict the intensity distribution in the pattern observed.

(ii) Obtain the expression for the first maximum from the central maximum.

CBSE-2022

52. There are mainly three ways to eject an electron from the surface of metals. What are those?

Assam Board-2017

53. Using Huygens wave theory prove that angle of incidence is equal to angle of reflection.

Kerala Board-2021

54. Using Huygens principle for the wave theory of light, verify the law of refraction.

Meghalaya Board-2017

55. Derive laws of reflection of light using Huygens' principle.

Meghalaya Board-2019, 2021

Maharashtra Board-2023

56. Using Huygen's principle, show that the angle of incidence is equal to the angle of reflection when a plane wave front is reflected by a plane surface.

Karnataka Board-March, 2020

57. Arrive at Snell's law of refraction, using Huygens's principle for refraction of a plane wave.

Karnataka Board-July, 2018

58. Using Huygens principle, show that the angle of incidence is equal to angle of reflection during a plane wave front reflected by a plane surface.

Karnataka Board-July, 2019

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59. Explain refraction on the basis of Huygens' principle and derive Snell's law?

Uttarakhand Board-2023
kerala Board-2021
ISC-2016

60. Describe the Huygens' principle of secondary wavelets.

Uttarakhand Board-2022

Section-D (Long Answer)

61. State laws of reflection and verify these using Huygen's wave theory.

J&K Board-2014, 2015, 2017, 2022

62. Define wavefront. State Huygen's principle. Using Huygen's construction show propagation of a plane wavefront.

Haryana Board-2018

63. Using Huygen's construction, explain reflection of a plane wave by a plane surface.

Haryana Board-2018

64. Define wavefront. State Huygen's principle. Using Huygen's contruction show propagation of a spherical wavefront.

Jharkhand Board-2019
Haryana Board-2018

65. (a) What is meant by a wave front ? Mention the direction of a beam of light with respect to the associated wavefront.
(b) With the help of a suitable diagram explain the Huygen's principle for the propagation of wavefront. How is a plane wave front produced ?

NIOS-2022

66. What is Huygens' theory of propagation of light waves ? Explain the refraction phenomenon of light with its help.

UP Board-2019, 2022

67. What is the meaning of wavefront? Explain the laws of reflection by explaining Huygens' principle of wavefront.

UP Board-2023

68. On the basis of Huygen's wave theory, prove Snell's law of refraction of light. Draw a neat and labelled diagram. [postulates of Huygen's wave theory not required.]

ISC- 2002, 2005, 2012, 2000
Jharkhand Board-2019

69. What is a wavefront ? How does it propagate? Using Huygens' principle, explain reflection of a plane wavefront from a surface and verify the laws of reflection.

CBSE-2020

70. Explain Huygen's principle of wave optics. Use this principle to prove the laws of refraction in case of a plane surface. 8. Various phenomena exhibited by light can be explained using the wave theory of light.
(a) Name the phenomenon which proves the transverse nature of light.
(b) What are the differences between interference and diffraction?
(c) A plane wave front is incident on a signal slit. Discuss the diffraction pattern formed by the slit. Represent the variation of intensity graphically.

Kerala Board-2013

71. Two coherent sources of light having intensity 81 : 1 produce interference fringes. Calculate the ratio of intensities at the maxima and minima in the interference pattern.

Maharashtra Board-2019

72. Give Huygen's principle with the help of a ray diagram. Prove the law of reflection.

Kerala Board-2016

73. State Huygen's Principle. Prove the laws of refraction on the basis of wave theory.

J&K Board-2011

II. Coherent and Incoherent Addition of Wave

Section-A (Multiple Choice Questions)

74. In the wave picture of light, the intensity I of light is related to the amplitude A of the wave as :

(a) $I \propto \sqrt{A}$ (b) $I \propto A$
(c) $I \propto A^2$ **(d)** $I \propto \frac{1}{A^2}$

CBSE-2023

Ans. (c) :

75. In interference pattern, using two coherent sources of light; the fringe width is____
(a) directly proportional to wavelength.
(b) inversely proportional to square of the wavelength.
(c) inversely proportional to wavelength.
(d) directly proportional to square of the wavelength.

Maharashtra Board-2018

Ans. (a) :

Section-B (Very Short Answer)

76. If amplitude of two coherent sources producing interference is in the ratio of 1 : 2, find ratio of I_{max} to I_{min}

J&K Board-2023

77. Write two conditions for two optical sources to become coherent source

MP Board-2017

OR

What do you understand by coherent source?

UP Board-2022
ISC-2014

78. Can two independent monochromatic sources of light be coherent ? Explain very briefly.

ISC-2000

79. Can two sodium vapour lamps act as coherent sources ? Explain in brief.

ISC-2009

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80. **(a) What do you understand by coherent sources?**
(b) Derive the expression for the intensity distribution in the interference pattern on the screen when two harmonic waves having same amplitude (a) and phase difference (ϕ) are superposed on each other. Hence obtain the conditions for constructive and destructive interference.
CBSE-2019

81. **What happens to the interference pattern when two coherent sources are**
(a) infinitely close, and
(b) far apart from each other
CBSE-2023

82. **Two coherent monochromatic light beams of intensities I and 4 I superpose each other. Find the ratio of maximum and minimum intensities in the resulting beam.**
CBSE-2023

83. **State two conditions for two light sources to be coherent.**
CBSE-2022

84. **Write the relation between the path difference and wavelength of light wave used for constructive and destructive of light.**
Karnataka Board-July, 2016

Section-C (Short Answer)

85. **Two coherent light waves of intensity 5×10^{-2} W m^{-2} each super-impose and produce the interference pattern on a screen. At a point where the path difference between the waves is $\lambda/6$, λ being wavelength of the wave, find the**
(a) phase difference between the waves.
(b) resultant intensity at the point.
(c) resultant intensity in terms of the intensity at the maximum.
CBSE-2020

86. **The equations of light wave from two sources are $y_1 = a_1 \sin \omega t$ and $y_2 = a_2 \sin(\omega t + \varphi)$ where the symbols have their usual meaning. The individual intensities are I_1 and I_2. Show that the minimum resultant intensity due to superposition is $I_{min} = I_1 + I_2 - 2\sqrt{I_1 I_2}$.**
Assam Board-2017

87. **What is a Coherent Source? State two differences between interference and diffraction.**
Assam Board-2014, 2015

Ans. () :

88. **What is interference? Write the condition for path difference in case of constructive and destructive interference.**
Karnataka Board-March, 2015

Section-D (Long Answer)

89. **Write the mass-energy equivalent relation. Who discovered the relation ? Calculate the mass equivalent of 9×10^{13}J energy. Does the relation have any experimental proof ?**
Assam Board-2023

90. **What are coherent sources? Define interference of light. Obtain the condition for constructive and destructive interference of light.**
Meghalaya Board-2018

91. **Explain refraction of light on the basis of wave theory. Hence prove the laws of refraction.**
Maharashtra Board-2019

III. Interference of Light and Young Double Slit Experimen

Section-A (Multiple Choice Questions)

92. **In Newton's ring experiment the radii of the mth and $(m+4)^{th}$ dark rings are respectively $\sqrt{5}$ mm and $\sqrt{7}$ mm. What is the value of m?**
(a) 2 (b) 4
(c) 8 (d) 10
Tamil Nadu Board-2017

Ans. (d) :

93. **Two light waves from slit S_1 and S_2 on reaching points P and Q on a screen in Young's double slit experiment have a path difference zero and $\lambda/4$ respectively. The ratio of light intensities at P and Q will be:**
(a) 4 : 1 (b) 3 : 2
(c) $\sqrt{2}$:1 (d) 2 : 1
Tamil Nadu Board-2023

Ans. (d) :

94. **In a Young's double - slit experiment , the width of the source slit is increased then ———–.**
(a) Fringe pattern gets more and more sharp
(b) Instead of interference, diffraction appears
(c) Angular distance between fringes increased
(d) Fringe pattern gets less and less sharp
Gujarat Board- March, 2020

Ans. (d) :

95. **The distance between two slits in Young's experiment is 0.2 mm. If the wavelength of light used is 5000 Å, the angular position of 3rd bright fringe from the central bright fringe is .....rad.**
(a) 0.75 (b) 0.075
(c) 0.0075 (d) 0.057
Gujarat Board- March, 2019

Ans. (c) :

96. **The number of interference fringes occurring in the broad diffraction peak depends on the ratio _____.**

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(a) $\frac{d^2}{a}$ (b) $\frac{a}{d}$

(c) $\frac{d}{a}$ (d) $\frac{a^2}{d}$

Where d = distance between two slits

a = width of slit

Gujarat Board-March, 2022

Ans. (c) :

97. Two waves whose intensities are in the ratio 9 : 1 produce interference. The ratio of maximum and minimum intensities will be

(a) 10 : 8 (b) 9 : 1

(c) 4 : 1 (d) 2 : 1

Jharkhand Board-2023

Ans. (c) :

98. The ratio of the dimensions of two light sources is 4:1. After the interference what will be the ratio of maximum and minimum intensities?

(a) 9:1 (b) 3:1

(c) 25:9 (d) 16:25

Chhattisgarh Board-2018

Ans. (b) :

99. In an interference experiment, third bright fringe is obtained at a point on the screen with a light of 700 nm. What should be the wavelength of the light source in order to obtain the fifth bright fringe at the same point?

(a) 420 nm (b) 750 nm

(c) 630 nm (d) 500 nm

CBSE-2023

Ans. (a) :

100. In a Young's double-slit experiment, the screen is moved away from the plane of the slits. What will be its effect on the following?

(i) Angular separation of the fringes.

(ii) Fringe-width.

(a) Both (i) and (ii) remain constant.

(b) (i) remains constant, but (ii) decreases.

(c) (i) remains constant, but (ii) increases.

(d) Both (i) and (ii) increase.

CBSE-2023

Ans. (c) :

101. In a Young -slit experiment, the fringe width is found to be β. If the entire apparatus is immersed in a liquid of refractive index μ, the new fringe width will be :

(a) β (b) μβ

(c) $\frac{\beta}{\mu}$ (d) $\frac{\beta}{\mu^2}$

CBSE-2023

Ans. (c) :

102. Assertion(A) : In Young's double slit experiment all fringes are of equal width.

Reason (R) : The fringe width depends upon wavelength of light (λ) used, distance of screen from plane of slits (D) and slits separation (d)

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, and Reason (R) is NOT the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is also false.

CBSE-2023

Ans. (a) :

103. In Young's double slit experiment, the interfering waves from the two sources have a path difference of 0 and $\frac{\lambda}{4}$ at points P and Q on the screen, respectively. The ratio of intensities at P and Q will be

(a) $\sqrt{2}:1$ (b) 4 : 1

(c) $1:\sqrt{2}$ (d) 2 : 1

CBSE-2020

Ans. (d) :

104. The slits in Young's experiment have widths in the ratio 1 : 16. The ratio of maxima and minima in the interference pattern is

(a) 1 : 16 (b) 1 : 4

(c) 5 : 3 (d) 25 : 9

Meghalaya Board-2019

Ans. (d) :

105. The displacements of interfering light waves are $y_1 = 4\sin\omega t$ and $y_2 = 3\sin(\omega t + \pi/2)$. The amplitude of the resultant wave is

(a) 5 (b) 7

(c) 1 (d) 0

Meghalaya Board-2019

Ans. (a) :

106. In a Young's double-slit experiment if the wavelength of light is doubled, then the fringe width will be

(a) doubled (b) halved

(c) unchanged (d) None of the above

Odisha Board-2022

Ans. (a) :

107. Phase-difference for constructive interference is

(a) $\phi = 2n\pi$ (b) $\phi = (2n + 1)\pi$

(c) $\phi = n\pi$ (d) $\phi = (n + 1)\pi$

Bihar Board-2021

Ans. (a) :

108. Width of interference fringe is

(a) $\beta = \frac{D\lambda}{d}$ (b) $\beta = \frac{d}{D\lambda}$

(c) $\beta = \frac{d\lambda}{D}$ (d) $\beta = d.\ D\lambda$

Bihar Board-2021

Ans. (a) :

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109. The path-difference in destructive interference is equal to

(a) $(n + 1)\lambda$ (b) $(2n + 1)\lambda$

(c) $(2n+1)\frac{\lambda}{2}$ (d) $\frac{(n+1)}{\lambda}$

Bihar Board-2022

Ans. (c) :

110. For constructive interference, the phase difference between two rays reaching at a point is

(a) zero (b) $\pi/2$

(c) π (d) $3\pi/4$

Bihar Board-2022

Ans. (a) :

111. Which is used to produce polarised light ?

(a) Prism of flint glass (b) NaCl prism

(c) Nicol prism (d) Biprism

Bihar Board-2023

Ans. (c) :

112. The reason for the phenomenon of interference is

(a) Phase difference

(b) Change in amplitude

(c) Velocity change

(d) Intensity change

Bihar Board-2023

Ans. (d) :

113. The value of maximum amplitude produced due to interference of two waves given by $Y_1 = 4\sin\omega t$ and $Y_2 = 3\cos\omega t$ is

(a) 7 (b) 5

(c) 1 (d) 25

Bihar Board-2023

Ans. (b) :

114. When the distance between source of light and screen is increased, then fringe width

(a) increases (b) decreases

(c) remains same (d) none of these

Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

115. Young's double slit experiment is performed by using green, red and blue monochromatic light sources, one at a time. The value of the fringe width will be maximum in case of _____ light.

CBSE-2020

116. In Young's double slit experiment, if the monochromatic source of light is replaced by another monochromatic source of shorter wavelength, the value of fringe width will _____ .

CBSE-2020

117. If the Young's apparatus be immersed in water in place of air, then what will be the effect on the Fringe width?

Haryana Board-2022

118. A plano-convex lens of radius 3m is placed on an optically flat glass plate and is illuminated by monochromatic light. The radius of the 8th dark ring is 3.6mm. Calculate the wavelength of light used.

Tamil Nadu Board-2018

119. Why the centre of Newton's rings is dark?

Tamil Nadu Board-September, 2016

120. In young's double slit experiment, the intensity ratio of two coherent sources is 81 : 1. Calculate the ratio between maximum and minimum intensities.

Tamil Nadu Board-September, 2016

121. In Young's experiment a light of frequency 6×10^{14}Hz is used. Distance between the centre of adjacent fringes is 0.75 mm. Calculate the distance between the slits if the screen is 1.5 m away.

Tamil Nadu Board-2015

122. Give two points of comparison for interference and diffraction pattern.

Gujarat Board- May, 2021

123. What do you understand by the term 'interference of light'? Mention the necessary conditions for sustained Interference.

Jharkhand Board-2020

124. What is destructive interference? Write its essential conditions (any two).

Chhattisgarh Board-2022

125. What will be the effect on fringe width in Young's double-slit experiment, if the distance between slit and screen increased?

Chhattisgarh Board-2022

126. "Only white and dark fringes are obtained when white light is used in Young's double slit experiment." Is this statement true? Justify.

Chhattisgarh Board-2019

127. Find the ratio of the intensities at two points X and Y on a screen in Young's double-slit experiment, where waves from S_1 and S_2 have path differences of (a) 0 and (b) $\frac{\lambda}{4}$.

NIOS-2015

128. What is meant by interference of light ? Write the necessary conditions for interference.

UP Board-2019

129. Obtain the formula for the fringe width with the help of Young's double slit experiment.

MP Board-2015, 2020, 2021

UP Board-2020

130. In Young's double slit experiment, using monochromatic light of wavelength 600 nm, the interference pattern was obtained on a screen kept 1.5m away from the plane of the two slits. Calculate the distance between the two slits, if fringe separation/fringe width was found to be 1.0 mm.

ISC-2012

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131. In Young's double slit experiment, if white light is used in place of monochromatic light, what changes are observed in the interference pattern ?

ISC-2004

132. Obtain the ratio of the interference fringe widths β_1 and β_2 obtained with monochromatic red light of λ_1 = 660 nm and ultraviolet light of λ_2 = 330 nm.

ISC-2003

133. How did Fresnel constructed a biprism in order to study interference of light ?

ISC-2012

134. State one condition for obtaining sustained interference of light.

ISC-2011, 2004

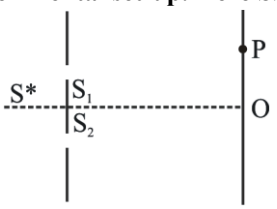
135. Young's double slit experiment was performed with monochromatic light of blue colour. The experiment was then repeated, first with light of red colour and then with light of yellow colour. Which colour pattern will have maximum separation (i.e., fringe width) ?

ISC-2010, 2008, 2006

136. How is fringe width of an interference pattern in Young's double slit experiment affected if the two slits are brought closer to each other ?

ISC-2017

137. The figure show a modified Young's double slit experimental set-up. Here $SS_2 - SS_1 = \lambda/4$



(a) Write the condition for constructive interference.

(b) Obtain an expression for the fringe width.

CBSE-2019

138. In a Young's double slit experiment, the separation between the two slits is d and distance of the screen from the slits is 1000 d. If the first minima falls at a distance d from the central maximum, obtain the relation between d and λ

CBSE-2023

139. (a) In a Young's double slit experimental set-up, the intensity of the light waves from two coherent sources are in the ratio of 4 : 9. Find the ratio of intensity of bright and dark fringes in the interference pattern.

(b) Light travels from a rarer to a denser medium. How will

(i) the energy carried, and

(ii) the wavelength of the light wave, be affected?

CBSE-2022

140. What happens to the fringe pattern if one of the slits in Young's double slit experimental set-up is closed ?

CBSE-2022

141. In Young's double slit experiment, the slit separation is 1 mm and the screen is 1 m away from the slits. For a monochromatic light of wavelength 500 nm, find

(a) the distance of third minima, and

(b) the distance of second maxima, from the central maxima.

CBSE-2022

142. How can you differentiate whether a pattern is produced by a single slit or double slits ? Derive the expression for the angular position of (i) bright and (ii) dark fringes produced in a single slit diffraction.

CBSE-2022

143. A beam of light consisting of two wavelengths 600 nm and 500 nm is used in a Young's double slit experiment. The slit separation is 1.0 mm and the screen is kept 0.06 m away from the plane of the slits. Calculate :

(i) the distance of the second bright fringe from the central maximum for wavelength 500 nm, and

(ii) the least distance from the central maximum where the bright fringes due to both the wavelengths coincide.

CBSE-2022

144. How is the spacing between fringes in a double slit experiment affected if :

(i) the slits separation is increased,

(ii) the colour of light used is changed from red to blue,

(iii) the whole apparatus is submerged in a oil of refractive index 1.2 ? Justify your answer in each case.

CBSE-2022

145. Give two points of difference between an interference pattern due to a double-slit and a diffraction pattern due to a single slit.

CBSE-2022

146. In a Young's double slit experiment using light of wavelength 600 nm, the slit separation is 0.8 mm and the screen is kept 1.6 m from the plane of the slits. Calculate :

(i) the fringe width

(ii) the distance of (a) third minimum and (b) fifth maximum, from the central maximum.

CBSE-2022

147. (i) Monochromatic light is incident on a surface separating two media. The frequency of the light after refraction remains unaffected but its wavelength changes. Why ?

(ii) The frequency of an electromagnetic radiation is 1.0×10^{11} Hz.

(iii) Identify the radiation and mention its two uses.

CBSE-2022

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148. A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 0.2 mm. If the resulting diffraction pattern is observed on a screen 1 m away, find the distance of
(i) first minimum, and
(ii) second maximum, from the central maximum.

CBSE-2022

149. In a single slit diffraction experiment, the width of the slit is increased. How will the (i) size and (ii) intensity of central bright band be affected? Justify your answer.

J&K Board-2021
CBSE-2020
Maharashtra Board-2018

150. Write the conditions on path difference under which (i) constructive (ii) destructive interference occur in Young's double slit experiment.

CBSE-2020

151. In Young's double slit experiment, when the monochromatic source is replaced by a source of white light, the central fringe becomes _____.

CBSE-2020

152. In Young's double slit experiment, the separation between the two slits is halved. The new fringe width will be _____ times its intial value.

CBSE-2020

153. In young's double slit experiment, the path difference between two interfering waves at a point on the screen is $\frac{5\lambda}{2}$, λ being wavelength of the light used. The _____ dark fringe will lie at this point.

OR

If one of the slits in Young's double slit experiment is fully closed, the new pattern has _____ central maximum in angular size.

CBSE-2020

154. In Young's experiment interference bands were produced on a screen placed at 150 cm from two slits, 0.15 mm apart and illuminated by the light of wavelength 6500 Å. Calculate the fringe width.

Maharashtra Board-2019

155. In Young's double-slit experiment, what happens to the fringe width if the distance between the slits is increased?

Odisha Board-2023

156. Derive the expression for the intensity at a point where interference of light occurs. Arrive at the conditions for maximum and zero intensity.

Telangana Board-2015

157. How does the angular width of interference fringes change in Young's experiment, if the distance between the slits is increased?

Uttarakhand Board-2023

158. Write down two necessary conditions for interference of light.

Bihar Board-2022, 2023

Section-C (Short Answer)

159. Two light sources of equal amplitudes interfere with each other. Calculate the ratio of maximum and minimum intensities.

Tamil Nadu Board-2023

160. In Newton's rings experiment, obtain an expression for the radius of the nth dark ring.

Tamil Nadu Board-2018

161. In Young's double slit experiment the slits are 2.5 mm apart and are at a distance of 2 m from the screen. Find the fringe width for light of wavelength 500 Å .

J&K Board-2017

162. To produce interference fringe pattern, draw a necessary diagram of young's double slit experiment. Derive an expression of fringe width for bright fringes.

Rajasthan Board-2023

163. Draw: (i) schematic diagram, (ii) fringe pattern, and (iii) intensity distribution graph for Young's double slit interference experiment.

Haryana Board-2018

164. What is interference of light waves? State two essential conditions to observe it.

Haryana Board-2018

165. Calculate fringe width in Young's experiment, if screen is placed at 1.5 m distance from the slits separated by 0.5 mm and wavelength of light used is 500 nm

Haryana Board-2018

166. Calculate fringe width in Young's experiment, if screen is placed at 1.0m distance from the slits separated by 0.5 mm and wavelength of light used is 600nm.

Haryana Board-2016

167. In Young's experiment a beam of light of wavelength 6500Å and 5200 Å is used. Find the minimum distance from the central bright fringe where bright fringes produced by both the wavelength get superposed. The distance between two slits is 0.5 mm and the distance between the slits and the screen is 100 cm.

Gujarat Board- May, 2021

168. Draw schematic diagram of Young's experiment and derive $\beta = \frac{\lambda D}{d}$ for the distance between two consecutive bright interference fringes.

Gujarat Board- March, 2020

169. A beam of light consisting of two wavelengths 650 nm and 520 nm is used to obtain interference fringes in Young's double slit experiment. Distance between two slits is 0.25 mm and slit & screen is 1 m .

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(a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.
(b) What is the least distance from the central maximum where the bright fringes due to both the wavelength coincide?

Gujarat Board-2023

170. A beam of light consisting of two wavelengths 6000 Å and 4000 Å, is used to obtain interference fringes in a Young's double-slit experiment.
a) Find the distance of the third dark fringe on the screen from the central maximum for wavelength 6000 Å .
b) What is the least distance from the central maximum where bright fringes due to both the wavelengths coincide?
(Distance between two slits = 0.1 mm. Take D = 100 cm)

Gujarat Board-March, 2022

171. The distance between the two slits in Young's experiment is 0.1 mm. The perpendicular distance between the slits and screen is 100 cm. Wavelength of the incident light is 6000Å. Calculate the distance between third bright and fifth dark fringes.

Gujarat Board- July, 2022

172. What do you understand by the term 'interference'? Describe Young's double slit experiment and discuss the formation of fringes.

Jharkhand Board-2023

173. Describe Young's double slit experiment with necessary theory and obtain expression for fringe width.

Jharkhand Board-2018

174. Write down four differences between interference and diffraction.

MP Board-2014, 2018
Tamil Nadu Board-2016

175. Deduce the fringe width in the Young's double slit experiments.

MP Board-2019

176. Derive the expression for the fringe width in Young's double slit experiment.

Chhattisgarh Board-2018

177. With the help of a diagram, describe the set up of Young's double slit experiment. Write conditions for the formation of bright and dark fringes in terms of (i) path difference (ii) phase difference.

NIOS-2017

178. In a Young's double slit experiment, the fringe width is found to be 4.2mm. If complete apparatus is immersed in a transparent oil of refractive index 1.4, calculate new fringe width.

NIOS-2019

179. In Young's double slit experiment using monochromatic light of wavelength 600 nm, 5th bright fringe is at a distance of 0.48 mm from the centre of the pattern. If the screen is at a distance of 80 cm from the plane of the two slits, calculate
(i) distance between the two slits.
(ii) fringe width, i.e. fringe separation.

ISC-2017

180. Laser light of wavelength 630 nm is incident on a pair of slits which are separated by 1.8 mm. If the screen is kept 80 cm away from the two slits, calculate
(i) fringe separation. i.e. fringe width
(ii) distance of 10th bright fringe from the centre of interference pattern.

ISC-2015

181. In Young' double slit experiment, using monochromatic light, the fringe are obtained on a screen placed at some distance from the slits. If the screen is moved by 5×10^{-2} m towards the slits, the change in the fringe width is 3×10^{-5} m. If the distance between the two slits is 10^{-3} m. Calculate the wavelength of the light used.

ISC-2014, 2005, 2004

182. In Young's double slit experiment using monochromatic light L_1 of wavelength 700 nm, 10th bright fringe was obtained at a certain point P on a screen.
Which bright fringe will be obtained at the same point P, if monochromatic light of wavelength 500 nm is used in place of L_1. (No other alterations were made in the experimental set up.)

ISC-2011

183. In Young's double slit experiment, what is meant by 'fringe width' of 'fringe separation' ? State two ways of increasing the fringe width without changing the source of light.

ISC-2009, 2001

184. The distance between the first and the sixth bright fringes formed in Young's double slit experiment (measured by a spectrometer) its found to be 12.5 mm. The separation between the slits 0.12 mm and the distance of the screen from the slits is 60 cm. Calculate
(i) the fringe width.
(ii) the wavelength of the light used (in nm).

ISC-2007, 2000

185. Answer the following questions:
(a) In a single slit diffraction experiment, the width of the slit is made double the original width. How does this affect the size and intensity of the central diffraction band?
(b) How is the width of the central maximum changed when red light is replaced by blue?
(c) In what way is diffraction from each slit related to the interference pattern in a double slit experiment?

CBSE-2019

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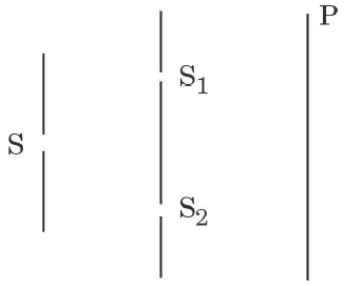
186. (a) (i) In diffraction due to a single slit, the phase difference between light waves reaching a point on the screen is 5π . Explain whether a bright or a dark fringe will be formed at the point.
(ii) What should the width (a) of each slit be to obtain eight maxima of two double-slit patterns (slit separation d) within the central maximum of the single slit pattern ?
(iii) Draw the plot of intensity distribution in a diffraction pattern due to a single slit.

OR

(b) (i) In a Young's double-slit experiment $SS_2 - SS_1 = \frac{\lambda}{4}$, where S_1 and S_2 are the two slits as shown in the figure. Find the path difference ($S_2P - S_1P$) for constructive and destructive interference at P.



(ii) What is the effect on the interference fringes in a Young's double-slit experiment, if the monochromatic source S is replaced by a source of white light ?

CBSE-2023

187. (a) In a Young' double slit experimental set-up, the intensity of the light waves from two coherent sources are in the ratio of 9 : 1. Find the ratio of intensity of bright and dark fringes in the interference pattern.

CBSE-2022

188. (a) The interference pattern is not observed in Young's double slit experiment when the two sources S_1 and S_2 are far apart. Explain.
(b) Mention the conditions for the two sources to be coherent.
(c) What is the effect on the interference pattern in a Young's double slit experiment, if the source of wavelength λ is replaced by another source of wavelength $1{\cdot}5\lambda$, with the interference pattern still observable ?

CBSE-2022

189. Briefly explain how bright and dark fringes are formed on the screen in Young's double slit experiment. Hence derive the expression for the fringe width.

CBSE-2022

190. Give reasons for each of the following :
(a) The intensity of light at some points on the screen in Young's double slit experiment is zero.
(b) The intensity of light transmitted by a polaroid is less than the intensity of the polarised light incident on it.
(c) In the single slit diffraction experiment, some coloured fringes around the central white maximum are observed on the screen when one uses a source of white light.

CBSE-2020

191. What is the effect on the interference fringes in Young's double slit experiment due to each of the following operations? Justify your answers.
(a) The screen is moved away from the plane of the slits.
(b) The separation between slits is increase.
(c) The source slit is moved closer to the plane of double slit.

CBSE-2020

192. Find the expression of fringe width $\beta = \frac{2\lambda}{2d}$ for Young's double slit interference pattern where 2d is the separation between the two coherent sources.

Assam Board-2014

193. Describe Young's double slit experiment and determine the conditions for obtaining bright and dark fringes.

Assam Board-2013

194. In a Young's double slit experiment two slits are made one millimeter apart and the screen is placed one meter away. What is the fringe separation when a monochromatic light of wavelength 500 nm is used?

Assam Board-2013

195. What is the de-Broglie wavelength of an electron in the Bohr's orbit of radius 0.51 Å in hydrogen atom?

Assam Board-2015

196. Young's double slit experiment is used to demonstrate interference of light.
(a) In Young's double slit experiments, 1 mm slit separation produces a bandwidth of 0.6 mm on a screen placed at a certain distance away from the slits. When the screen is moved further away from the slits through 0.25 m, the bandwidth becomes 0.75 mm. Find the initial separation between slits and screen.
(b) If one of the slits is closed still dark and bright bands are observed on the screen. This is due to
(a) Interference (b) Polarisation
(c) Reflection (d) Diffraction

Kerala Board-2017

197. We obtained alternate dark and bright regions if we look at the shadow by an obstacle closed to geometrical shadow.
(a) Mention the phenomenon behind it.

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(b) Differentiate the interference pattern with a coherently illuminated single slit diffraction pattern.

Kerala Board-2014

198. Describe Young's experiment in interference with necessary theory.

Kerala Board-2014

199. Using a schematic diagram derive an expression for the fringe width in Young's double slit experiment.

Kerala Board-2016

200. In a biprism experiment, light of wavelength 5200 Å is used to get an interference pattern on the screen. The fringe width changes by 1.3 mm when the screen is moved towards biprism by 50 cm. Find the distance between two virtual images of the slit.

Maharashtra Board-2018

201. In a biprism experiment, the fringes are observed in the focal plane of the eye-piece at distance of 1.2 m from the slit. The distance between the central bright band and the 20th bright band is 0.4 cm. When a convex lens is placed between the biprism and the eye-piece, 90 cm from the eye-piece, the distance between the two virtual magnified images is found to be 0.9 cm. Determine the wavelength of light used.

Maharashtra Board-2023

202. Two coherent sources S_1 and S_2 separated by a certain distance d, produced an interference pattern on a screen. Obtain an expression for path difference between the waves reaching a point on the screen at a distance y from the centre of the pattern. Hence find the expression for fringe width for constructive interference only.

Goa Board-2019

203. Assuming the expression for the path difference between two waves meeting at a point on the screen, obtain an expression for the fringe width in Young's double slit experiment. When are two sources of light said to be coherent?

Goa Board-2018

204. In young's double slit experiment when a source of light of wavelength 5000 Å is used the fringe width obtained is 0.6cm. If the distance between slit and screen is reduced to half, calculate the new fringe width.

Manipur Board-2022

205. Obtain the expression for the fringe width of interference fringes in Young's double slit experiment.

Karnataka Board-March, 2020

206. Explain Young's double slit-experiment.

Karnataka Board-July, 2015

207. What are coherent sources? In Young's double slit experiment, wave length of light used is 6000 Å. The distance between slits is 0.05 cm and distance of screen from slits is 1m. Calculate the fringe width. 3

Uttarakhand Board-2019

Section-D (Case-Based Questions)

208. How will the interference pattern in Young's double-slit experiment be affected if:

(a) The screen is moved away from the plane of the slits.

(b) The source slit is moved away from the plane of the slits.

(c) The phase difference between the light waves emanating from the two slits S_1 and S_2 changes from 0 to π and remains constant.

CBSE-2022

209. The British physicist Thomas Young explained the interference of light using the principle of superposition of waves. He observed the interference pattern on the screen, in his experimental set-up, known now as Young's double slit experiment. The two slits S_1 and S_2 were illuminated by light from a slit S. The interference pattern consists of dark and bright bands of light. Such bands are called fringes. The distance between two consecutive bright and dark fringes is called fringe width.

(a) If the screen is moved closer to the plane of slits S_1 and S_2, then the fringe width :

(i) will decrease, but the intensity of bright fringe remains the same.

(ii) will increase, but the intensity of bright fringe decreases.

(iii) will decrease, but the intensity of bright fringe increases.

(iv) and the intensity both remain the same.

(b) What will happen to the pattern on the screen, when the two slits S_1 and S_2 are replaced by two independent but identical sources ?

(i) The intensity of pattern will increase

(ii) The intensity of pattern will decrease

(iii) The number of fringes will become double

(iv) No pattern will be observed on the screen

(c) Two sources of light are said to be coherent, when both emit light waves of :

(i) same amplitude and have a varying phase difference.

(ii) same wavelength and a constant phase difference.

(iii) different wavelengths and same intensity.

(iv) different wavelengths and a constant phase difference.

(d) The fringe width in a Young's double slit experiment is β. If the whole set-up is immersed in a liquid of refractive index 'μ', then the new fringe width will be :

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(i) β (ii) $\beta\mu$

(iii) $\frac{\beta}{\mu}$ (iv) $\frac{\beta}{\mu^2}$

(e) The total path difference between two waves meeting at points P_1 and P_2 on the screen are $\left(\frac{3\lambda}{2}\right)$ and 2λ respectively. Then :

(i) bright fringes are formed at both points.

(ii) dark fringes are formed at both points.

(iii) a bright fringe is formed at P_1 and a dark fringe is formed at P_2.

(iv) a bright fringe is formed at P2 and a dark fringe is formed at P_1.

CBSE-2022

210. The principle of superposition is used to understand the phenomenon of interference of light waves. The principle states that at a particular point, the resultant displacement produced by a number of waves is the vector sum of the displacements produced by each wave. Light waves from two coherent sources produce interference pattern. Thomas Young devised a way to obtain two coherent sources using two identical pinholes (S_1 and S_2) illuminated by a single monochromatic pinhole source S. Using these sources in his experiment known as Young's double slit experiment, Youngs studied the interference pattern. The pattern consists of alternate bright and dark fringes. The distance between two successive bright or dark finges depends on the distance between S_1 and S_2, the distance of the screen from the plane of S_1S_2 and the wavelength of light used.

I. Consider the following waves :

(i) $y_1 = a \sin \omega t$

(ii) $y_2 = a \sin 2\omega t$

(iii) $y_3 = a \sin (2\omega t + \phi)$

(iv) $y_4 = a \sin\left(4\omega t + \frac{\pi}{2}\right)$

Which pair of the waves coming from two sources S_1 and S_2 will produce interference ?

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (ii) and (iv)

(d) (iv) and (i)

II. Two light waves of the same intensity I_0 each, having a path difference of $\lambda/4$, emanating from two coherent sources, meet at a point. The resultant intensity at the point will be

(a) Zero

(b) I_0

(c) $2\ I_0$

(d) $4\ I_0$

III. Vandana performs Young's double slit experiment by using orange, green and red lights successively. If the fringe width measured in the three cases are ω_1, ω_2 and ω_3 respectively, then which of the following is correct ?

(a) $\omega_2 > \omega_1 > \omega_3$

(b) $\omega_1 > \omega_2 > \omega_3$

(c) $\omega_2 > \omega_3 > \omega_1$

(d) $\omega_3 > \omega_1 > \omega_2$

IV. In a Young's double slit experiment, the slit separation is 0.8 mm and the interference pattern is obtained on a screen kept 50 cm from the plane of the slits S_1 and S_2. If the first bright fringe is formed 0.4 mm from the central maximum, the wavelength of light used is

(a) 480 nm

(b) 560 nm

(c) 640 nm

(d) 680 nm

V. Consider the effect on the angular separation of the fringes in a Young's double slit experiment due to the following operations:

(i) the screen is moved away from the plane of the slits,

(ii) the separation between the two slits is increased till fringes are observed.

Which of the following options is correct ?

(a) It remains constant in both cases.

(b) It decrease in both cases.

(c) It remains constant in (i) but decreases in (ii).

(d) It decreases in (i) but remains constant in (ii).

CBSE-2022

211. The principle of superposition is used to understand the phenomenon of interference of light waves. The principle states that at a particular point, the resultant displacement produced by a number of waves is the vector sum of the displacements produced by each wave. Light waves form two coherent sources produce interference pattern. Thomas Young devised a way to obtain tow coherent sources using two identical pinholes (S_1 and S_2) illuminated by a single monochromatic pinhole source S. Using these sources in his experiment known as Young's double slit experiment. Young studied the interference pattern. The pattern consists of alternate bright and dark fringes. The distance between two successive bright or dark fringes depends on the distance between S_1 and S_2 , the distance of the screen from the plane of S_1 S_2 and the wavelength of light used.

(I) Consider the following waves:

(i) $y_1 = a \sin \omega t$

(ii) $y_2 = a \sin 2\omega t$

(iii) $y_3 = a \sin (2\omega t + \phi)$

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(iv) $y_4 = a \sin\left(4\omega t + \frac{\pi}{2}\right)$

Which pair of the waves coming from two sources S_1 and S_2 will produce interface?

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (iii) and (iv)

(d) (iv) and (i)

(II) Two light waves of the same intensity I_0 each. having a path difference of $\lambda/4$ emanating from two coherent sources. meet at a point. The resultant intensity at the point will be

(a) Zero

(b) I_0

(c) $2\ I_0$

(d) $4\ I_0$

(III) Vandana performs Young's double slit experiment by using orange, green and red lights successively. If the fringe widths measured in the three cases are ω_1 , ω_2, ω_3 respectively, then which of the following is correct?

(a) $\omega_2 > \omega_1 > \omega_3$

(b) $\omega_1 > \omega_2 > \omega_3$

(c) $\omega_2 > \omega_3 > \omega_1$

(d) $\omega_3 > \omega_1 > \omega_2$

(IV) In a Young's double slit experiment, the slit separation is 0.8 mm and the interference pattern is obtained on a screen kept 50 cm from the plane of the slits S_1 and S_2. If the first bright fringe is formked 0.4 mm from the central maximum, the wavelength of light used is

(a) 480 nm

(b) 560 nm

(c) 640 nm

(d) 680 nm

(V) Consider the effect on the angular separation of the fringes in a Young's double slit experiment due to the following operations:

(i) the screen is moved away from the plane of the slits.

(ii) the separation between the two slits is increased till fringes are observed.

Which of the following option is correct?

(a) It remains constant in both cases.

(b) It decreases in both cases.

(c) It remains constant in (i) but decreases in (ii)

(d) It decreases in (i) but remains constant in (ii)

CBSE-2020

212. What is meant by interference of light? Give any two conditions for obtaining sustained interference pattern of light. Why two separate light bulbs cannot produce a sustained interference pattern of light?

Meghalaya Board-2013

Section-E (Long Answer)

213. What is polarisation of light? Explain polarisation of light by reflection with the suitable diagram and hence derive Brewster's law.

Punjab Board-2018

214. In the Young's double slit experiment, two slits 0.125 mm apart are illuminated by light of wavelength $4500A^o$. The screen is 1m away from the plane of the slits. Find the separation between second bright fringes on both sides of central maxima.

Punjab Board-2018

215. Obtain the equation for bandwidth in Young's Double slit Experiment.

Tamil Nadu Board-2022

216. Using Young's double slit experiment derive an expression for fringe width.

J&K Board-2018

217. Deduce the conditions of maxima and minima in Young's double slit experiment and find an expression for fringe width.

J&K Board-2014, 2015, 2016

Tamil Nadu Board-2017

218. Define fringe width. Derive an expression for fringe width in Young's double slit experiment of interference of light.

J&K Board-2023

219. Explain Young' s double slit experiment to produce interference pattern due to monochromatic source of light. Deduce an expression for fringe-width.

Nagaland Board-2018

220. Derive the expression for the fringe width of the bright and dark fringes in Young's double slit experiment for interference of light.

Nagaland Board-2020

221. The distance between the two slits in Young's experiment is 0.1 mm. The perpendicular distance between the slits and the screen is 1.5m. The wavelength of the incident light is 6000Å, Calculate the distance between third bright and fifth dark fringes, obtained on the screen.

Gujarat Board- March, 2020

222. In Young's experiment, the distances between two slits and that between slits and screen are 0.05 cm and 1m, respectively. Find the distance between 3rd bright and 5th dark fringes. Take the wavelength of light equal to $5000\,\mathring{A}$.

Gujarat Board- March, 2019

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223. What do you understand by interference of light? Two waves with amplitudes a_1 and a_2 and angular frequency ω are imposed. Find the intensity in case of constructive interference and destructive interference.

Chhattisgarh Board-2021

224. (a) Describe Young's double slit experiment to produce interference and hence derive an expression for the width of the interference fringes.

(b) What would happen to the interference pattern obtained in Young's double slit experiment when

(i) One of the slits is closed

(ii) The distance of the screen the slits is increased.

NIOS-2018

225. Derive mathematical formula for the width of interference fringes obtained in Young's double - slit experiment. What will be the effect on decreasing the separation between the two slite on the width of interference fringes?

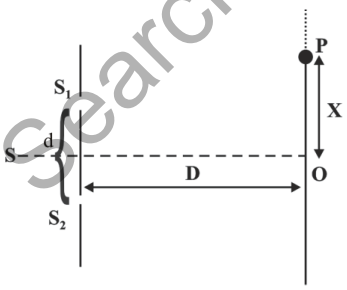
UP Board-2021

226. With the help of a labelled diagram, show that fringe separation β in Young's double slit experiment is given by $\beta = \frac{\lambda D}{d}$ where, the terms have their usual meaning.

ISC-2015, 2013, 2006

227. (a) Can the interference pattern be produced by two independent monochromatic sources of light ? Explain.

(b) The intensity at the central maximum (O) in a Young's double slit experimental set-up shown in the figure is I_O. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P, would equal $\frac{I_O}{4}$.



(c) In Young's double slit experiment the slits are separated by 0.5 mm and screen is placed 1.0 m away from the slit. It is found that the 5th bright fringe is at a distance of 4.13 mm from the 2nd dark fringe. Find the wavelength of light used.

Or

(a) Derive the relation $a \sin\theta = \lambda$ for the first minimum of the diffraction pattern produced due to a single slit of width 'a' using light of wavelength λ.

(b) State with reason, how the linear width of central maximum will be affected if (i) monochromatic yellow light is replaced with red light and (ii) distance between the slit and the screen is increased.

(c) Using the monochromatic light of same wavelength in the experimental set-up of the diffraction pattern as well as in the interference pattern where the slit separation is 1 mm, 10 interference fringes are found to be within the central maximum of the diffraction pattern. Determine the width of the single slit, if the screen is kept at the same distance from the slit in the two cases.

CBSE-2019

228.(a) Why cannot the phenomenon of interference by observed by illuminating two pin holes with two sodium lamps ?

(b) Two monochromatic waves having displacements $y_1 = a \cos \omega t$ and $y_2 = a \cos(\omega t + \phi)$ from two coherent sources interfere to produce an interference pattern. Derive the expression for the resultant intensity and obtain the conditions for constructive and destructive interference.

(c) Two wavelengths of sodium light of 590 nm 596 nm are used in turn to study the diffraction taking place at a single slit of aperture 2×10^{-6}m. If the distance between the slit and the screen is 1.5 m, calculate the separation between the positions of the second maxima of diffraction pattern obtained in the two cases.

CBSE-2019

229. (a) Describe any two characteristic feature which distinguish between interference and diffraction phenomena. Derive the expression for the intensity at a point of the interference pattern in Young's double slit experiment.

(b) In the diffraction due to a single slit experiment the aperture of the slit is 3 mm. If monochromatic light of wavelength 620 nm is incident normally on the slit, calculate the separation between the first order minima and the 3rd order maxima on one side of the screen. The distance between the slit and the screen is 1.5 m.

CBSE-2019

230. (2) Name any two factors on which the fringe width in a Young's double-slit experiment depends.

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(ii) In Young's double-slit experiment, the two slits are separated by a distance equal to 100 times the wavelength of light that passes through the slits. Calculate :
(1) the angular separation in radians between the central maximum and the adjacent maximum.
(2) the distance between these two maxima on a screen 50 cm from the slits.

CBSE-2023

231. (a) Briefly describe the Young's double slit experiment of interference of light. Drive the expression for fringe width in the pattern.
(b) Monochromatic light of wavelength 588 nm is incident from air to water interface. Find the wavelength and speed of the refracted light. The refractive index of water is $\frac{4}{3}$.

CBSE-2020

232. A beam of light consisting of wavelengths $6500\,\mathring{A}$ and $5200\,\mathring{A}$ is used in Young's double slit experiment of slit separation 2mm and where the screen in 120cm away. Find the distance to the third fringe from the central maximum for the wavelength $6500\,\mathring{A}$. What is the least distance from the central maximum at which the bright fringes due to both wavelengths coincide? 1+4 = 5

Assam Board-2016

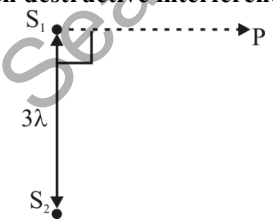
233. Show that the fringe width is given by

$$\beta = \frac{D\lambda}{d}$$

Where D is the distance between the source and the screen, λ is the wavelength of light and d is the distance between the two sources.

Meghalaya Board-2014, 2017, 2021

234. Figure shows two coherent sources S_1 and S_2 emitting waves of wavelength λ . The distance between the two sources is 3λ. Find in terms of λ , the maximum distance from S_1 along S_1P, for which destructive interference occurs:



Goa Board-2023

235. Define fringe width. Derive expression for fringe width in interference pattern.

J&K Board-2020

236. Define fringe width. Derive an expression for fringe width in case of Young's double slit experiment of interference of light.

J&K Board-2019

237. Describe Young's double-slit experiment for the interference of light. Obtain the expression for fringe width.

Odisha Board-2020

238. In a young's double slit experiment distance between the slits is 1mm. The fringe width is found to be 0.6 mm. When the screen is moved through a distance of 0.25 m away from the plane of the slit, the fringe width becomes 0.75 mm. Find the wavelength of light used.

Karnataka Board-March, 2015

239. In a Young's double slit experiment wave length of light used is $5000\,\mathring{A}$ and distance between the slits is 2 mm, distance of screen from the slits is 1m. Find fringe width and also calculate the distance of 7th dark fringe from central bright fringe.

Karnataka Board-March, 2019

240. In Young's double slit experiment the slits are separated by 0.28 mm and the screen is placed at a distance of 1.4 m away from the slits. The distance between the central bright fringe and the fifth dark fringe is measured to be 1.35 cm. Calculate the wavelength of the light used. Also find the fringe width if the screen is moved 0.4 m towards the silts, for the same experimental set up.

Karnataka Board-July, 2018

241. Light of wave length $600\,\mathring{A}$ is used to obtain interference fringes of width 6mm in a Young's double slit experiment. Calculate the wave length of light required to obtained fringe of width 4 mm when the distance between the screen and slits is reduced to half of its initial value.

Karnataka Board-March, 2017

242. Derive an expression for the fringe width of interference fringes in a double slit experiment.

Karnataka Board-July, 2014, 2019
Karnataka Board-July, 2014, 2020

243. Derive the expression for the fringe width of interference pattern in Young's double-slit experiment.

Karnataka Board-July, 2018

244. In Young's double slit experiment while using a source of light of wavelength $4500\,\mathring{A}$, the fringe width is 5 mm. If the distance between the screen and the plane of the slits is reduced to half, what should be wavelength of light to get fringe width 4mm?

Karnataka Board-July, 2016

245. A beam of light consisting of two wave lengths 4200 A and 5600 A is used to obtain interference fringes in young's double slit experiment. The distance between the slits is 0.3 mm and the distance between the slits and the screen is 1.5m. Compute the least distance

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of the print from the central maximum, where the bright fringes due to both the wavelengths coincide.

Karnataka Board-July, 2015

246. Explain interference of light and mention essential conditions for it. Derive the formula for fringe width of bright fringe by giving the principle of Young's experiment.

Uttarakhand Board-2020

247. What do you understand by Interference of light waves? Describe the Young's double-slit experiment for interference of light and obtain an expression for Fringe Width.

Uttarakhand Board-2022

IV. Diffraction of Light

Section-A (Multiple Choice Questions)

248. When a drop of water is introduced between the glass plate and plano convex lens in Newton's rings system, the ring system :

(a) Remains same
(b) Contacts
(c) First expands, then contracts
(d) Expands

Tamil Nadu Board-2018

Ans. (b) :

249. A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced by blue light ?

(a) Diffraction pattern becomes narrower and crowded together
(b) Bands disappear
(c) Diffraction pattern becomes broader and farther apart
(d) No change

Tamil Nadu Board-2015, 2018

Ans. (a) :

250. In Fraunhoffer diffraction by a single slit. the width of the slit is 0.01 cm. If the wavelength of light incident normally on the slit is 6000 Å the angular distance of second maximum from the mid line of central maximum is ——rad.

(a) 0.075 (b) 0.15
(c) 0.015 (d) 0.030

Gujarat Board- May, 2021

Ans. (c) :

251. The amount of Rayleigh scattering is _____.

(a) inversely proportional to fourth power of wavelength
(b) inversely proportional to wavelength
(c) directly proportional to wavelength
(d) directly proportional to fourth power of wavelength.

Gujarat Board-2023

Ans. (d) :

252. A slit of size'a' is illuminated by a parallel beam of light of wavelength λ. The angle at which this light is diffracted is approximately ___.

(a) $\frac{a^2}{\lambda}$ (b) $\frac{\lambda}{a^2}$
(c) $\frac{\lambda}{a}$ (d) $\frac{a}{\lambda}$

Gujarat Board-2023

Ans. (c) :

253. A diffraction pattern is obtained by making blue light incident on a narrow slit. If blue light is replaced by red light, then the diffraction bands ..... .

(a) disappear (b) become broader
(c) become narrower (d) remain same

Maharashtra Board-2020

Ans. (b) :

254. The tip of a needle does not give a sharp image on a screen. This is due to :

(a) Polarization (b) Interference
(c) Diffraction (d) Refraction

J&K Board-2020

Ans. (c) :

255. The width of diffraction fringes is .....to the width of interference fringes.

(a) equal (b) unequal
(c) similar (d) none of these

Bihar Board-2023

Ans. (a) :

Section-B (Very Short Answer)

256. In a single slit diffraction experiment, the phase difference between the waves originating from the two edges of the slit at the first minimum of the diffraction pattern is ____ rad.

CBSE-2020

257. Write the formula which shows the relation between fresnel distance wavelength of light and size of aperture.

Rajasthan Board-2023

258. Derive Bragg's law of X-ray diffraction.

Tamil Nadu Board-2015

259. A parallel beam of monochromatic light is allowed to incident normally on a plane transmission grating having 5000 lines per centimeter. A second order spectral line is found to be diffracted at an angle of 30°. Find the wavelength of the light.

Tamil Nadu Board-2015

260. Distinguish between Fresnel and Fraunhofer types of diffraction.

Tamil Nadu Board-2023

261. What is scattering of light?

Haryana Board-2016

262. When one can notice the phenomenon of diffraction of light?

MP Board-2018

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263. What do you understand by diffraction of light?
MP Board-2021

264. What do you understand by diffraction of light? What is the necessary condition for it ?
Chhattisgarh Board-2023

265. If the light source is slit-shaped, then what type of waveform is formed?
Chhattisgarh Board-2021

266. Write the two differences between Fresnel and Fraunhofer diffraction. [1+1=2]
Chhattisgarh Board-2020

267. State any one difference between interference of light and diffraction of light.
ISC-2015

268. Fraunhofer diffraction from a single slit of width 1.24×10^{-6} m is observed with the light of wavelength 6200 Å. Calculate the angular width of the central maximum.
ISC-2005

269. (i) What is meant by diffraction of light ?
(ii) In Frauhofer diffraction, what kind of source of light is used and where is it situated ?
ISC-2017

270. Monochromatic light of wavelength 650 nm falls normally on a slit of width 1.3×10^{-4} cm and the resulting Frauhofer diffraction is obtained on a screen. Find the angular width of the central maxima.
ISC-2016

271. Show graphically, the intensity distribution in Frauhofer's single slit diffraction experiment. Label the axes.
ISC-2015

272. What will be the effect on the width of the central bright fringe in the diffraction pattern of a single slit, if
(i) the monochromatic light of smaller wavelength is used.
(ii) slit is made narrower.
ISC-2013

273. Draw a labelled graph to show the variation in intensity of diffracted light with angular position, in a single slit diffraction experiment.
ISC-2012, 2009, 2007

274. A slit of width 0.6 mm is illuminated by a beam of light consisting of two wavelengths 600 nm and 480 nm. The diffraction pattern is observed on a screen 1.0 m from the slit Find:
(i) The distance of the second bright fringe from the central maximum pertaining to light of 600 nm.
(ii) The least distance from the central maximum at which bright fringes due to both the wavelengths coincide.
CBSE-2022

275. In a diffraction pattern due to a single slit, how will the angular width of central maximum change, if
(i) Orange light is used in place of green light,
(ii) the screen is moved closer to the slit,
(iii) the slit width is decreased?
Justify your answer in each case.
CBSE-2022

276. A parallel beam of hight of wavelength 600 nm is incident normally on a slit of width 0.2 mm. If the resulting diffraction pattern is observed on a screen 1 m aways, find the distance of
(i) first minimum, and
(ii) second maximum, form the central maximum,
CBSE-2020

277. Explain why the bluish colour predominates in a clear sky.
Kerala Board-2020

278. When a low flying aircraft passes over head, we sometimes notice a slight shaking of the picture on our TV screen. Identify the optical phenomenon behind it.
Kerala Board-2014

279. What is diffraction of light ?
Karnataka Board-July, 2020
Meghalaya Board-2019
Karnataka Board-March, 2019

280. Name the optical phenomenon due to which the sky appears blue.
Meghalaya Board-2015

281. Write the difference between interference and diffraction.
Uttarakhand Board-2023

282. What will be the focal length of lens-combination of a convex lens of focal length 20 cm in contact with a concave lens of focal length 30 cm?
Uttarakhand Board-2022

283. Does the principle of conservation of energy hold for interference and diffraction phenomena? Explain briefly.
AP Board-2020

Section-C (Short Answer)

284. What is meant by diffraction of light? Deduce the condition for the position of secondary minima of diffraction pattern in terms of path difference. Also, find the expression for width of central maxima.
Meghalaya Board-2023

285. What is diffraction of light ? Explain the intensity distribution graph due to diffraction from a single slit.
Haryana Board-2018

286. In Fraunhoffer diffraction, the wavelength of light incident normally on the slit is $\frac{d}{2}$, where d is the width of the slit. What will be the maximum number of bright fringes formed on an infinitely extended screen placed at any distance from the slit.
Gujarat Board- May, 2021

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287. A parallel beam of light of wavelength 500nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of screen. Find the width of the slit.

Gujarat Board- August, 2020

288. Obtain an expression for width of central maxima by diffraction of light at a single slit.

Chhattisgarh Board-2018

289. Explain the meaning of diffraction. Draw intensity distribution curve in the diffraction pattern of light diffracted from a narrow slit. What will be the effect on the width of fringes and intensity, if width of the slit is doubled?

UP Board-2021

290. Determine the angular separation between the central maxima and the first order maxima of the diffraction pattern due to a single slit of width 0.25 mm when light of wavelength 5890 Å is incident on its normally.

ISC-2006, 2000

291. Obtain the relation, d sinθ = λ for the first minima of the diffraction pattern of a single slit of width d using light of wavelength λ.

ISC-2001

292. (a) In single slit diffraction, explain why the maxima at $\theta = \left(n + \frac{1}{2}\right)\left(\frac{\lambda}{a}\right)$ becomes weaker and weaker as n increases. State two important differences between interference and diffraction pattern.

CBSE-2022

293. (b) Monochromatic light of wavelength 600 nm is incident from air on a water surface. If the refractive index of water is $\frac{4}{3}$, then find the wavelength of the refracted light.

CBSE-2022

294. Briefly explain how bright and dark fringes are formed on a screen due to the diffraction at a single slit. Hence, explain why the intensity at the bright fringes decreases sharply as their order (n) increases.

CBSE-2022

295. (A) Interference and diffraction of light waves produce alternate dark and bright regions called fringes

(a) Regarding the fringe width choose the correct statement.

(i) Interference fringes are of unequal width.

(ii) Diffraction fringes are of same width.

(iii) Interference fringes are of equal width and diffraction fringes are of different width.

(iv) Both interference and diffraction fringes are of different width.

Kerala Board-2016

296. Why is the sky usually blue, but it appears red at sunrise and sunset?.

Odisha Board-2023

297. Explain what is Brewster's law.

Odisha Board-2023

298. What do you understand by diffraction? Write the difference between diffraction and interference.

J&K Board-2021

Uttarakhand Board-2020

Section-D (Case-Based Questions)

299. Ram is using yellow light in a single slit diffraction experiment with slit of width 0.6 mm. The teacher replaces yellow light by X-rays. Now he is not able to observe diffraction pattern. He feels sad. Again the teacher replaces X-rays by yellow light and the diffraction pattern appears again. The teacher now explains the facts :

Questions :

(a) Which value is displayed by the teacher ?

(b) Give the necessary conditions for diffraction.

J&K Board-2023

300. What is meant by diffraction of light? Show graphically the relative intensity distribution for a single-slit diffraction pattern as a function of sin θ and write the condition for the first secondary minimum of diffraction pattern in terms of path difference.

Meghalaya Board-2015

Section-E (Long Answer)

301. What is the essential condition for diffraction of light to occur?

Punjab Board-2018

302. Explain diffraction of light due to a single slit and illustrate formation of a pattern of fringes obtained on the screen and plot a graph showing variation of intensity with angle θ in single slit diffraction.

Nagaland Board-2018

303. Define diffraction of light. Explain single slit experiment for diffraction of light.

Haryana Board-2018

304. Explain single slit experiment for diffraction of light.

Haryana Board-2016

305. Intensity of diffracted light at any point on the screen is given by the formula $I = I_0\left(\frac{\sin\alpha}{\alpha}\right)^2$, using this formula obtain condition for central maximum, minima and maxima. Where I_0 = maximum intensity and $\alpha = \frac{\pi d \sin\theta}{\lambda}$.

Gujarat Board- March, 2019

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306. Discuss the diffraction of monochromatic light through a narrow single slit. Find out the expression for angular width of central maxima.

UP Board-2022

307. Light of wavelength 600 nm, falls normally on a slit of width 1.2 μm producing Fraunhoffer diffraction pattern on a screen. Calculate the angular position of the first minima and the angular width of the central maxima.

ISC-2002

308. Diffraction of light is bending of light around the corners of an object whose size is comparable with the wavelength of light. Diffraction actually defines the limits of ray optics. This limit for optical instruments is set by the wavelength of light. An experimental arrangement is set up to observe the diffraction pattern due to a single slit.

Answer the following questions based on the above :

(a) How will the width of central maximum be affected if the wavelength of light is increased ?

(b) Under what condition is the first minimum obtained ?

(c) Write two points of difference between interference and diffraction patterns.

CBSE-2023

309. Two students are separated by a 7 m partition wall in a room 10 m high. If both light and sound ves can bend around obstacles, how is it that the students are unable to see each other even though they can converse easily ?

CBSE-2023

310. Write two points of difference between an interference pattern and a diffraction pattern.

CBSE-2023

311. A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is obtained on a screen 1 m away. If the first minimum is formed at a distance of 2.5 mm from the centre of the screen, find the (i) width of the slit, and (ii) distance of first secondary maximum from the centre of the screen.

CBSE-2020

312. Discuss the phenomena of diffraction produced by a single slit by drawing a neat diagram.

Assam Board-2023

313. In a diffraction phenomenon, radius of the central bright region is given as $r_o \approx \frac{1.22\lambda f}{2a}$, where λ is wavelength of the light, f is the focal length of the lens used and 2a is the diameter of the aperture. Show that in order to observe two objects clearly by a microscope, the minimum separation between them must be $\frac{1.22\lambda}{2\sin\beta}$, where β is the angle between principal axis of the objective and the ray of light from the object to the apex of the lens.

Assam Board-2016

314. What is blue shift? Sodium light of wavelength $5890\,\mathring{A}$ travelling from a galaxy is observed to be $5896\,\mathring{A}$. What is the speed of the galaxy?

Assam Board-2015

315. A long narrow slit is illuminated by blue light and the diffraction pattern is obtained on a white screen.

(a) How the width of bands change as the distance from the centre increases?

(b) What happens to the width of pattern, if yellow light is used instead of blue light?

(c) In a double slit experiment, the slits are separated by 0.03 cm and the screen is placed 1.5 m away. The distance between the central fringe and the fourth bright fringe is 1 cm. Determine the wavelength of light used in the experiment.

(d) What do you mean by limit of resolution of an optical instrument?

Kerala Board-2020

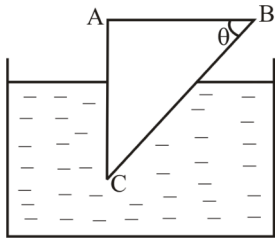
316. Monochromatic light of wavelength 4300Å falls on a slit of width 'a'. For what value of 'a' the first maximum falls at 30º?

Maharashtra Board-2019

317. A right angled prism is kept partially inside water as shown in the figure. A ray of light is incident normally on face AB. It is observed that the ray of light just grazes along the surface BC after falling on it. Find the value of θ.

R.I. of material of prism is $\frac{3}{2}$.

R.I. of water is $\frac{4}{3}$.



Goa Board-2019

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V. Polarization of Light

Section-A (Multiple Choice Questions)

318. The chromium ions doped in the ruby rod:
(a) absorbs red light
(b) absorbs green light
(c) absorbs blue light
(d) emits green light

Tamil Nadu Board-March, 2016

Ans. (b) :

319. Transverse nature of light is shown in :
(a) scattering
(b) interference
(c) polarisation
(d) diffraction

Tamil Nadu Board-2022

Ans. (c) :

320. Which of the following phenomena shows that light is a transverse wave?
(a) Diffraction of light
(b) Refraction of light
(c) Polarization light
(d) Interference of light

Jharkhand Board-2019

Ans. (c) :

321. The phenomenon of polarization of light indicates that:
(a) Light is not a wave
(b) Light is a longitudinal. Wave
(c) Light is transverse wave
(d) Light travels with a speed of 3×10^8 ms^{-1}

J&K Board-2018

Ans. (c) :

322. From_____ phenomenon of optics, one can say that light rays are transverse.
(a) Reflection (b) Diffraction
(c) Interference (d) Polarisation

Gujarat Board- August, 2020

Ans. (d) :

323. Unpolarised light is incident on a plane glass surface. What should be the angle of incidence so that the reflected and refracted rays are perpendicular to each other. [μ=1.54]
(a) 55º (b) 30º
(c) 57º (d) 45º

Gujarat Board- August, 2020

Ans. (c) :

324. Unpolarised light is incident on a plan glass surface. What should be the angle of incidence so that the reflected and refracted rays are perpendicular to each other?
(a) 37° (b) 33°
(c) 53° (d) 57°

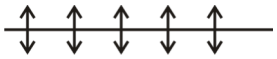
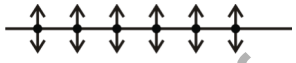
Gujarat Board- March, 2020

Ans. (d) :

325. Unpolarized light is incident on a plane transparent surface. The reflected and refracted rays are found perpendicular to each other. Then the angle of incidence is ___. [Refractive index of the medium is 1.73]
(a) 30º (b) 45º
(c) 90º (d) 60º

Gujarat Board-2023

Ans. (d) :

326. Which one of the following figure represents polarization in the plane of the paper?
(a)
(b) 
(c) 
(d)

Gujarat Board- July, 2022

Ans. (b) :

327. An optically active substance:
(a) rotates the plane of polarized light
(b) changes the direction of polarized light
(c) does not allow plane polarized light to pass through it
(d) none of these

NIOS-2021

Ans. (a) :

328. A transparent Polaroid plate is placed on a similar plate such that the angle between the directions of polarization is 30°. Un-polarized light is incident on one plate. The ratio of intensities of emergent light to that incident un-polarized light is
(a) 1 : 4 (b) 1 : 3
(c) 3 : 4 (d) 3 : 8

UP Board-2017

Ans. (d) :

329. If polarizing angle is α and critical angle is β, then
(a) $\tan\alpha \times \sin\beta = 1$ (b) $\cot\alpha \times \sin\beta = 1$
(c) $\tan\alpha \times \cos\beta = 1$ (d) $\cot\alpha \times \cos\beta = 1$

UP Board-2020

Ans. (a) :

330. The relationship between Brewster angle θ and the speed of light v in the denser medium is
(a) $c\cos\theta = v$ (b) $v\tan\theta = c$
(c) $c = v\tan\theta$ (d) $v\cos\theta = c$

CBSE-2020

Ans. (b) :

331. Glass plate of refractive index 1.732 is to be used as a polariser, its polarizing angle is___.
(a) 30° (b) 45°
(c) 60° (d) 90°

Maharashtra Board-2018

Ans. (c) :

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Section-B (Very Short Answer)

332. Mention any five uses of polaroids.
Tamil Nadu Board-2022
Tamil Nadu Board-March, 2016
Maharashtra Board-2015
Tamil Nadu Board-2016

333. What are the factors on which optical rotation depends on?
Tamil Nadu Board-2011

334. Explain the polarisation by reflection and derive Brewster's Law.
Gujarat Board- August, 2020

335. Derive Brewster's law in the case of polarisation by reflection.
Gujarat Board- July, 2022

336. State Brewster's law. Prove that if light is incident at the angle of polarization the reflected and refracted rays are mutually perpendicular.
MP Board-2015

337. What is a polaroid? Write any two applications.
MP Board-2018

338. The polarizing angle of a transparent medium is 30^0. Calculate the angle of refraction.
MP Board-2022

339. Which waves between heat waves and sound waves can be polarised? [1]
Chhattisgarh Board-2019

340. When a beam of unpolarised light falls on any transparent material, the reflected beam, in general, is partially plane polarised. What happens when the light is incident at the polarising angle? Establish the relation between polarising angle and the refractive index of the reflecting transparent medium, with the help of a ray diagram.
NIOS-2012

341. State Brewster's law and give its one application.
NIOS-2018

342. What is Brewster's law ? For light incident at 60° angle of incidence on plane transparent medium, reflected light is completely plane polarized. Find the refractive index of the medium and angle of refraction.
UP Board-2017

343. What is the difference between polarised light and unpolarised light based on the direction of electric vector (E) ?
ISC-2016, 2013, 2007

344. A ray of ordinary light is travelling in air. It is incident on air-glass pair at a polarizing angle of 56°. Find the angle of refraction in glass.
ISC-2015, 2013

345. Give any two methods by which (ordinary) light can be polarised.
ISC-2015, 2009, 2005

346. (i) State Brewster's law of polarisation of light.
(ii) How will you identify with the help of an experiment, whether a given beam of light is of polarised light or unpolarised light ?
ISC-2014, 2007

347. A ray of light is incident on a transparent medium at polarising angle. What is the angle between the reflected ray and the refracted ray ?
ISC-2014

348. The critical angle for a given transparent medium and air is i_c. A ray of light travelling in air is incident on this transparent medium at an angle of incidence equal to the polarising angle i_p. What is the relation between the two angle i_c and i_p ?
ISC-2013, 2009

349. State Brewster's law of polarisation of light.
ISC-2012, 2002, 2000

350. The refractive index of glass w.r.t. air is 3/2. Find the angle of polarisation.
ISC-2004

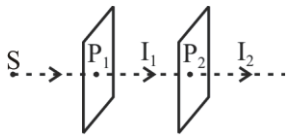
351. (i) State Brewster's law.
(ii) Find Brewster's angle for a transparent liquid having refractive index 1.5.
ISC-2017

352. A certain monochromatic light travelling in the air is incident on a glass plate at a polarising angle. Angle of refraction in the glass is found to be 32°. Calculate
(i) the polarising angle.
(ii) refractive index of glass.
ISC-2011, 2003, 2001

353. Distinguish between unpolarized and linearly polarized light
CBSE-2019

354. When unpolarised light is incident on the interface separating the rarer medium and the denser medium. Brewster angle is found to be 60°. Determine the refractive index of the denser medium.
CBSE-2019

355. Light from a sodium lamp (S) passes through two Polaroid sheets P_1 and P_2 as shown in fig. What will be the effect on the intensity of the light transmitted (i) by P_1 and (ii) by P_2 on rotating Polaroid P_1 about the direction of propagation of light? justify your answer in both cases.



CBSE-2020

356. In a linearly polarized light, the electric vector oscillates along a direction perpendicular to the aligned molecules of the polaroid, called _____ axis.
CBSE-2020

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357. The value of Brewster's angle for air-glass interface is $\frac{\pi}{3}$, hence the refractive index of glass is _____.
CBSE-2020

358. An unpolarised light of intensity I_0 is passed through a polaroid. The intensity of a plane polarized light obtained is _____ .
CBSE-2020

359. Unpolarised light passes from a rarer into a denser medium. If the reflected and the refracted rays are mutually perpendicular, the reflected light is linearly polarized _____ to the plane of incidence.
CBSE-2020

360. (d) What is the Brewster angle for air to glass transition? (Refractive index of glass is 1.5).
Kerala Board-2014

361. Two polaroids are aligned so that the intensity of light emerging out of them is maximum. Through what angle one of them should be rotated so that intensity of light emerging out of them is reduced to half ?
Goa Board-2019

362. State malus law and Brewster's law.
J&K Board-2011

363. What are Polaroid's? Give their two uses.
J&K Board-2011

364. State Brewster's law.
Manipur Board-2022

365. For which angle of incidence reflected ray is completely polarized?
Karnataka Board-March, 2019

366. Mention two applications of polaroids.
Karnataka Board-March, 2016

367. What os polarization of light? Name any one method of producing plane polarized light.
Karnataka Board-July, 2018

368. Write the formula for Malus law?
Karnataka Board-July, 2016

369. Explain 'Malu's law' for Polaroid.
Karnataka Board-March, 2014

370. What is Polaroid ? Write its one application.
Bihar Board-2022

Section-C (Short Answer)

371. Name the property of light that proves its transverse nature.
Kerala Board-2021

372. (a) Good quality sunglasses made of polaroids are preferred over ordinary coloured glasses. Explain why.
(b) How is plane polarized light defined?
(c) A beam of plane polarized light is passed through a Polaroid. Show graphically, variation of the intensity of the transmitted light with angle of rotation of the Polaroid.
CBSE-2019

373. For a given medium, the polarising angle is 60° What will be the critical angle for this medium?
J&K Board-2016

374. What is Polarisation? With the help of a diagram explain plane of polarization and plane of vibration.
J&K Board-2015

375. What is Polarisation? With the help of a diagram explain plane of polarisation and plane of vibration.
J&K Board-2014

376. Define polarizing angle. Derive the relation connecting polarizing angle and the refractive index of a medium.
Nagaland Board-2018

377. State Brewster's law. Hence show that when a ray of light is incident at polarizing angle, the reflected ray is at right angle to the refracted ray.
Nagaland Board-2021

378. What is polarization of light? Explain the polarization by reflection.
Haryana Board-2018

379. Explain polarization of light by reflection with a diagram. Define angle of polarization.
Haryana Board-2017

380. Explain polarization by reflection of light. Calculate the refractive index of a medium if angle of polarization is 60°.
Haryana Board-2017

381. What is polarization of light? Explain polarization by scattering.
Haryana Board-2016

382. State and prove Brewster's law.
Gujarat Board- March, 2019

383. What is meant by polarization of light ? Briefly describe a method to obtain the plane polarized light.
UP Board-2019

384. What is meant by the polarization of light ? Two polaroids A and B are placed crossed with each other. How a third Polaroid is to be placed in between them such that the light transmitted form B have intensity $\frac{1}{32}$ that of the intensity of unpolarised light incident on A?
UP Board-2020

385. Explain why light waves can be polarised but sound waves cannot ? Describe a method by which a plane polarised light can be distinguished from a partially polarised light.
ISC-2005

386. (a) Explain, using a suitable diagram, how unpolarized light gets linearly polarized by scattering.
(b) Describe briefly the variation of the intensity of transmitted light when a polaroid sheet kept between two crossed polaroids is rotated. Draw the graph depicting the variation of intensity with the

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angle of rotation. How many maxima and minima would be observed when θ varies from 0 to π?

CBSE-2019

387. (a) Explain how an unpolarised light gets polarised when incident on the interface separating the two transparent media.
(b) Green light is incident at the polarising angle on a certain transparent medium. The angle of refraction is 30°. find
(i) polarising angle, and
(ii) refractive index of the medium.

CBSE-2019

388. A beam of unpolarised light of intensity 2 mW passes successively through two parallel polarizing sheets P_1 and P_2. If the angle between the pass axes of P_1 and P_2 is made 60°, find the intensity of light transmitted by P_1 and P_2.

CBSE-2020

389. Show that when a ray of light is incident on the surface of a transparent medium at polarising angle, the reflected and the refracted rays are at right angles to each other.

Assam Board-2017

390. Establish Brewster's Law of polarization of light.

Assam Board-2015

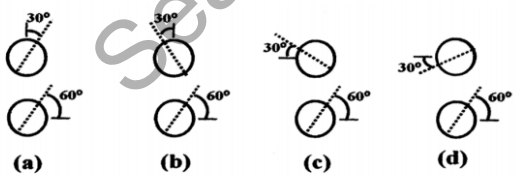
391. If a ray of unpolarised light is made to incident at the polarizing angle on a glass slab then show that the reflected and refracted rays will be along mutually perpendicular directions.

Kerala Board-2017

392. State and prove Brewster's law.

Meghalaya Board-2017

393. The figure shows four pairs of Polaroids' seen from front. Each pair is mounted in the path of initially unpolarized light. The axis of polaroids is shown with dotted lines. Through which pair the intensity of light seen is:
(a) maximum?
(b) minimum?



Goa Board-2023

394. State and explain Brewster's law of polarization of light.

J&K Board-2019

395. Mention any three applications of Polaroid's.

Karnataka Board-March, 2016, 2017

396. What is polarization of light ? Mention two methods of producing plane polarized light.

Karnataka Board-July, 2020

397. What is Brewster's law? Prove that when light incident on a transparent plane at polarising angle then reflected and refracted rays are perpendicular to each other.

Uttarakhand Board-2020

Section-D (Long Answer)

398. Explain polarisation by scattering.

Gujarat Board- March, 2020

399. (a) Explain the phenomenon of polarization of ligh. Draw a schematic arrangement of apparatus used for it.
(b) How unpolarised light is plane polarized by reflection from a transparent material? Show it by drawing a ray diagram.
(c) Derive and expression for Brewster's law.

NIOS-2021

400. Distinguish between the polarised and un-polarised light. Explain, how can polarised light be experimentally detected?

NIOS-2019

401. State Brewster's law. The polarising angle of a medium is 60^0. Calculate its refractive index.

NIOS-2019

402. Explain, with the help of a diagram, how plane polarized light can be produced by scattering of light from the Sun.
Two polaroids P_1 and P_2 are placed with their pass axes perpendicular to each other. Unpolarised light of intensity I is incident on P_1. A third polaroid P_3 is kept between P_1 and P_2 such that its pass axis makes an angle of 45° with that of P_1. Calculate the intensity of light transmitted through P_1, P_2 and P_3.

CBSE-2019

403. (a) What is meant by plane polarised light ? An unpolarised light is incident at an angle θ on the surface of glass of refractive index μ. If the reflected and refracted rays are perpendicular to each other, then obtain the relationship between μ and θ.
(b) Two polaroids P_1 and P_2 are placed in a crossed position. Unpolarised light of intensity I_0 is incident on P_1. If P_2 is rotated through an angle θ about the direction of propagation of light, keeping P_1 fixed, plot the graph of intensity of light for $0^o < \theta < 360^o$ which is (i) transmitted by P_1, and (ii) transmitted by P_2.

CBSE-2020

404. State Brewster's law and show that when light is incident at polarizing angle the reflected and refracted rays are mutually perpendicular to each other.

Maharashtra Board-2019

405. (b) If the critical angle of a medium is $\sin^{-1}\left(\frac{3}{5}\right)$, find the polarizing angle.

Maharashtra Board-2015

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11. Dual Nature of Matter and Radiation

I. Photo Electric Effect

Section-A (Multiple Choice Questions)

1. The graph between cut-off potential and frequency of incident radiation in photo electric effect is
(a) a straight line passing through the origin
(b) a straight line not passing through the origin
(c) a circle
(d) an ellipse

Odisha Board-2020

Ans. (b) :

2. At the threshold frequency, the velocity of the electrons is :
(a) Zero (b) Maximum
(c) Minimum (d) Infinite

Tamil Nadu Board-2016

Ans. (a) :

3. Emission of electrons by the absorption of heat energy is called ____ emission.
(a) Thermionic (b) Photo electric
(c) Secondary (d) Field

Tamil Nadu Board-2022

Ans. (a) :

4. The threshold frequency of a photosensitive surface is 5×10^{14} Hz. Then which of the following will produce photoelectric effect from the same surface?
(a) Sodium vapour lamp (b) Ruby laser
(c) He-Ne laser (d) Both (b) and (c)

Tamil Nadu Board-2017

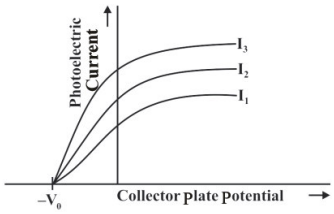
Ans. (a) :

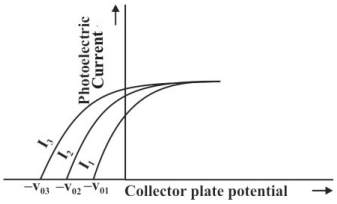
5. The photoelectric effect can be explained on the basis of:
(a) corpuscular theory of light
(b) wave theory of light
(c) electromagnetic theory of light
(d) quantum theory of light

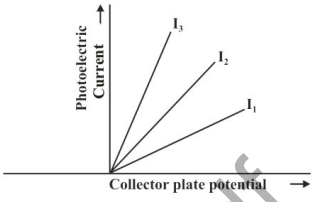
Tamil Nadu Board-2017

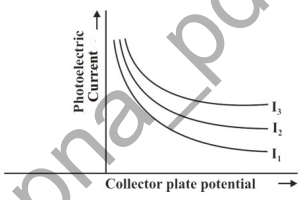
Ans. (d) :

6. In an experimental study of photoelectric effect, the correct graph between collector plate potential and photoelectric current for different intensities of incident radiation

(a)


(b)


(c)


(d)


Rajasthan Board-2022

Ans. (a) :

7. The photoelectric cut-off voltage in a certain experiment is 1.6V. The maximum kinetic energy of emitted photoelectron is ____.
(a) 1.6 keV (b) 2.56 eV
(c) 2.56×10^{-19} J (d) 1.6×10^{-19} J

Gujarat Board- August, 2020

Ans. (c) :

8. Value of stopping potential depends on —— of incident light.
(a) Intensity (b) Frequency
(c) Momentum (d) Velocity

Gujarat Board- March, 2020

Ans. (b) :

9. The slope of the graph of the stopping potential (V_0) → frequency (v) for the photoelectric effect is equal to _____.
(a) $\frac{e}{h}$ (b) $\frac{h}{e}$
(c) h (d) $\frac{h}{2\pi}$

Gujarat Board-March, 2022
UP Board-2020

Ans. (b) :

10. In a photoelectric experiment, it both the intensity and frequency of incident light are doubled, then saturation photoelectric current.
(a) remains constant
(b) is halved

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(c) becomes four times
(d) is doubled

Jharkhand Board-2019

Ans. (d) :

11. The photoelectric cut-off voltage in a certain experiment is 1.5V. The maximum kinetic energy of emitted photoelectrons is
(a) 1.5×10^{-19}J (b) 1.5×10^{-10}J
(c) 2.4×10^{-19}J (d) 1.6×10^{-19}J

Jharkhand Board-2018

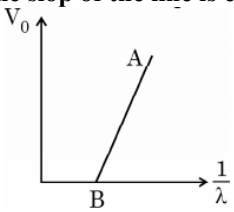
Ans. (c) :

12. On increasing the frequency of radiation causing photoelectric emission from a metal surface
(a) number of photoelectrons will increase
(b) number of photoelectrons will decrease
(c) kinetic energy of photoelectrons will increase
(d) kinetic energy of photoelectrons will remain unchanged.

UP Board-2021

Ans. (c) :

13. Figure shows a plot of stopping potential (V_0) versus $\frac{1}{\lambda}$, where λ is the wavelength of the radiation causing photoelectric emission from a surface. The slop of the line is equal to



(a) ϕ_0 (b) $\frac{h}{e}$
(c) $\frac{hc}{e}$ (d) $\frac{h^2c}{e^2}$

CBSE-2023

Ans. (b) :

14. Assertion (A) : Photoelectric effect demonstrates the particle nature of light.
Reason (R) : Photoelectric current is proportional to intensity of incident radiation for frequencies more than the threshold frequency.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.

CBSE-2023

Ans. (d) :

15. A photocell connected in an electrical circuit is placed at a distance 'd' from a source of light. As a result, current I flows in the circuit. What will be the current in the circuit, when the distance is reduced to 'd/3'?
(a) I (b) 6I
(c) 9I (d) $\frac{1}{3}$I

CBSE-2020

Ans. (c) :

16. A photo-cell connected in an electrical circuit is placed at a distance 'd' from a source of light. As a result current I flows in the circuit. What will be the current in the circuit when the distance is increased to '2d' ?
(a) 2I (b) $\frac{I}{4}$
(c) $\frac{I}{2}$ (d) 4I

CBSE-2020

Ans. (b) :

17. If the maximum kinetic energy of emitted electrons in photoelectric effect is 2eV, the stopping potential will be _____.
(a) 0.5 V (b) 1.0 V
(c) 1.5 V (d) 2.0 V

Maharashtra Board-2023

Ans. (d) :

18. The phenomenon of photoelectric effect was first explained by:
(a) Bohr (b) Plank
(c) Hallwacks (d) Einstein

J&K Board-2011

Ans. (d) :

19. The shape of graph between maximum kinetic energy of photoelectrons and frequency of incident radiation is
(a) straight line (b) circle
(c) ellipse (d) parabola

Odisha Board-2022

Ans. (a) :

20. Which of the following phenomena of light supports its quantum nature?
(a) diffraction (b) polarisation
(c) interference (d) photoelectric effect

Bihar Board-2022

Ans. (d) :

21. In photoelectric effect, the photoelectric current is independent of
(a) intensity of incident light
(b) potential difference applied between two electrodes
(c) the nature of emitter material
(d) frequency of incident light

Bihar Board-2023

Ans. (d) :

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Section-B (Very Short Answer)

22. Write any five applications of photoelectric cell.
Tamil Nadu Board-September, 2016

23. What is photoelectric effect? State the laws of photoelectric emission.
Tamil Nadu Board-2015
MP Board -2015

24. List out the laws of photo electric effect.
Tamil Nadu Board-2022
MP Board-2017

25. Mention any three applications of laser in medical field.
Tamil Nadu Board-2011

26. State laws of photoelectric emission.
J&K Board-2018, 2020
Haryana Board -2016
J&K Board-2014, 2015
MP Board -2013

27. What is the effect of decrease in wavelength of incident light on the velocity of photoelectrons?
J&K Board-2023

28. What determines the strength of photoelectric current?
J&K Board-2023

29. If the intensity of incident radiation on a metal is doubled, what happens to the kinetic energy of emitted photoelectrons?
Nagaland Board-2018

30. Explain the effect of potential on photoelectric current with the help of its figure.
Nagaland Board-2020

31. Write the characteristics of photoelectric emission.
Gujarat Board- May, 2021

32. What called Thermionic emission, field emission and photoelectric emission? Also define threshold frequency.
Gujarat Board- July, 2022

33. What is photoelectric effect? Define threshold frequency and stopping potenial.
Jharkhand Board-2020

34. What is meant by threshold frequency in the photoelectric effect?
MP Board-2021

35. What is thermionic emission ?
Chhattisgarh Board-2023
MP Board-2019

36. What will be the effect on number of photoelectrons as you increase the intensity of incident light?
Chhattisgarh Board-2022

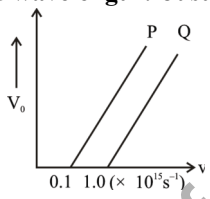
37. What are main four observations from the experimental study of photo-electric effect?
NIOS-2021

38. Describe in brief what is observed when moving electrons are allowed to fall on a thin graphite film and the emergent beam falls on a fluorescent screen.
ISC-2017

39. In photoelectric effect, what is meant by the term threshold frequency ?
ISC-2011, 2001, 2014

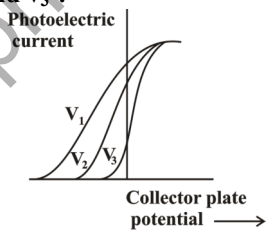
40. Plot a graph showing the variation of photoelectric current versus intensity of light.
CBSE-2019

41. The figure shows the variation of stopping potential V_0 with the frequency v of the incident radiations for two photosensitive metals P and Q. Which metal has smaller threshold wavelength? Justify your answer.



CBSE-2019

42. On the basis of the graphs shown in the figure, answer the following questions :
(a) Which physical parameter is kept constant for the three curves ?
(b) Which is the highest frequency among v_1, v_2 and v_3 ?



CBSE-2019

43. (a) Define the terms,
(i) threshold frequency and (ii) stopping potential in photoelectric effect.
(b) Plot a graph of photocurrent versus anode potential for a radiation of frequency v and intensities I_1 and I_2 ($I_1 < I_2$).
J&K Board -2019, 2021
CBSE-2019

44. (a) Give an example each of a metal from which photoelectric emission takes place when irradiated by (i) UV light (ii) visible light.
CBSE-2022

45. (b) (i) Name the factors on which photoelectric emission from a surface depends.
(ii) Define the term 'threshold frequency' for a photosensitive material.
CBSE-2022

46. Photoelectrons are emitted from a metal surface when illuminated with UV light of wavelength 330 nm. The minimum amount of energy required to emit the electrons from the surface is 3.5×10^{-19} J. Calculate :
(i) the energy of the incident radiation, and
(ii) the kinetic energy of the photoelectron.
CBSE-2022

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47. Light of same wavelength is incident on three photo-sensitive surfaces A, B and C. The following observations are recorded.
(a) From surface A, photo electrons are not emitted.
(b) From surface B, photo electrons are just emitted.
(c) From surface C, photo electrons with some kinetic energy are emitted.
Compare the threshold frequencies of the three surfaces and justify your answer.

OR

If the frequency of light incident on the cathode of a photo-cell is increased, how will the following be affected? Justify your answer.
(i) Energy of the photo electrons.
(ii) Photo current.

CBSE-2020

48. In photoelectric effect, the number of emitted photoelectrons is proportional to _____ of incident light.

CBSE-2020

49. Light of frequency v is incident on a photosensitive surface of threshold frequency v_0 ($v > v_0$). The value of kinetic energy of the emitted photoelectrons will be _____.

CBSE-2020

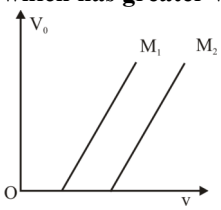
50. Ultra-violet light of wavelength 200 nm from a source is incident on a metal surface. If the stopping potential is –25 V, (a) calculate the work function of the metal, and (b) How would the surface respond to a high intensity red light of wavelength 6328 Å produced by a laser?

CBSE-2020

51. Plot suitable graphs to show the variation of photoelectric current with the collector plate potential for the incident radiation of
(i) the same intensity but different frequencies v_1, v_2 and v_3 (v_1, v_2 , v_3)
(ii) the same frequency but different intensities I_1, I_2 and I_3 ($I_1 < I_2 < I_3$)

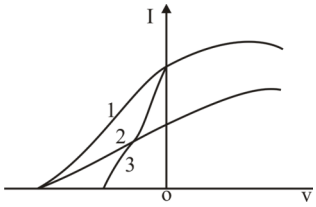
CBSE-2020

52. The variation of the stopping potential (V_0) with the frequency (v) of the light incident on two different photosensitive surfaces M_1 and M_2 is shown in the figure, Identify the surface which has greater value of the work function.



CBSE-2020

53. The three curves shown below, represent the variation of photocurrent and applied voltage for two different materials using two different intensities of a monochromatic light. Identify the two curves which are for the same material.



CBSE-2020

54. Find the wavelength of an electron accelerated through a potential difference of 1 Volt.

Assam Board-2014

55. Write down Einstein's photo electric equation and explain each of its terms.

Assam Board-2014

56. State the basic processes involved in the generation of e.m.f in a solar cell when light falls on it.

Assam Board-2013

57. Find the dimension of Planck's constant.

Assam Board-2013, 2015

58. What is the dimension of work function?

Assam Board-2016

59. Pick the correct material suited for exhibiting photoelectric effect from the following:
Arsenic, Copper, Zinc, Gold, Argon

Kerala Board-2017

60. What is the effect of intensity of incident light on photoelectric current ?

Meghalaya Board-2019

61. Is it always necessary to use red light to get photoelectric effect?

Maharashtra Board-2022

62. What is Threshold frequency and Stopping potential?

J&K Board-2021

63. Define threshold frequency and stopping potential.

J&K Board-2019

64. Can photoelectric effect be explained by wave theory of light?

Odisha Board-2023

65. Write down Einstein's photoelectric equation and explain it.

Odisha Board-2022

66. Write any two types of electron emission.

Karnataka Board-March, 2014

67. Ultraviolet light is incident on two photosensitive materials having work function Φ_1 and Φ_2 ($\Phi_1 > \Phi_2$). In which of the case will K.E. of emitted electrons be greater?

Uttarakhand Board-2023

68. What is "Photoelectric effect"?

AP Board-2020

Section-C (Short Answer)

69. The threshold wavelength of silver is 3800 Å. Calculate the maximum kinetic energy in eV of photoelectrons emitted, when ultraviolet light of wavelength 2600 Å falls on it.

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(Plank's constant, $h = 6.63 \times 10^{-34}$ J.s.,
Velocity of light in air, $c = 3 \times 10^{8}$ m/s)

Maharashtra Board-2015

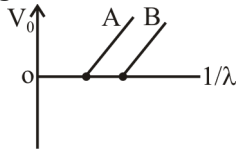
70. Define the term 'threshold frequency'. How is photoelectric current affected due to the increase in the (a) frequency and (b) intensity of the incident radiation ?

Meghalaya Board-2017

71. In case of photo electric effect experiment, explain the following facts, giving reasons.
(a) The wave theory of light could not explain the existence of the threshold frequency.
(b) The photo electric current increases with increase of intensity of incident light.

CBSE-2020

72. Figure shows the stopping potential (V_0) for the photo electron versus ($1/\lambda$) graph, for two metals A and B, λ being the wavelength of incident light.



(a) How is the value of Planck's constant determined from the graph ?
(b) if the distance between the light source and the surface of metal A is increased, how will the stopping potential for the electrons emitted from it be effected ? Justify your answer.

CBSE-2020

73. Why it is the frequency and not the intensity of light source that determines whether emission of photoelectrons will occur or not ? Explain.

CBSE-2022

74. What is photoelectric effect? State the laws of photoelectric emission.

Tamil Nadu Board-March, 2016

75. Write any five applications of photo electric cells.

Tamil Nadu Board-2017

76. What is photoelectric effect? Derive the Einstein's equation.

J&K Board-2023
Chattisgarh Board-2019
Mp Board-2023
AP-2023

77. Draw and explain the graph showing the variation of stopping potential with frequency of incident radiation in relation to photoelectric effect.

Nagaland Board-2018

78. What is a photocell ? On what principle does a photocell work ? Write any two applications of a photocell.

Nagaland Board-2021
Bihar Board - 2023

79. Explain effect of potential on photoelectric current.

Haryana Board-2018

80. Light of frequency 7.21×10^{14} Hz is incident on a metal surface. Electrons with a maximum speed of 6.0×10^{5} m/s are ejected from the surface. What is the threshold frequency for photoemission of electrons?
($m_e = 9.1 \times 10^{-31}$ kg and $h = 6.6 \times 10^{-34}$ Js)

Jharkhand Board-2019

81. What is photo electric effect ? Explain any two laws of photo electric effect based on Einstein equation.

Chhattisgarh Board-2023
Nagaland Board-2021

82. Explain photoelectric effect. Write Einstein photoelectric equation and explain the laws of photoelectric emission on its basis.

UP Board-2021

83. What is meant by photoelectric effect? Write the explanation given by Einstein for this effect.

UP Board-2022

84. Threshold wavelength of certain metal is 792 nm. What is the maximum kinetic energy of photoelectrons emitted by this metal, if it is exposed to ultraviolet light of wavelength 396 nm ?

ISC-2010

85. The threshold wavelength for a metal is 3315 Å. What should be the wavelength of light incident on the metal surface so that the maximum kinetic energy of the emitted photoelectrons be 1.25 eV ?

CBSE-2023

86. Lights of wavelengths 430 nm, 450 nm and 660 nm are incident on a metal surface whose threshold wavelength is 600 nm. In which case/cases will photoemission take place and why ? Calculate the threshold frequency of the metal surface.

CBSE-2022

87. What is photo electric effect? Why is photo electric current proportional to the intensity of incident radiation?

Assam Board-2013

88. The threshold frequency for a certain metal is 3.3×10^{14} Hz. If a light of frequency 8.2×10^{14} Hz is incident on that particular metal, calculate the cutoff voltage for photoelectric emission.

Assam Board-2023

89. Briefly explain the effect of intensity and energy of the incident radiation on the photo electric effect.

Kerala Board-2013

90. With neat labelled circuit diagram, describe an experiment to study the characteristics of photoelectric effect.

Maharashtra Board-2023

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91. **Write any three experimental observations of photoelectric effect.**

Karnataka Board-July, 2018
Karnataka Board-March, 2019

92. **What is Photoelectric effect? Clarify the meaning of 'work function' and 'threshold frequency' for photoelectric emission.**

Uttarakhand Board-2022

93. **What is photoelectric effect? Write Laws of Photoelectric effect.**

Uttarakhand Board-2019

94. **When light of wavelengths 400 nm and 500 nm are allowed to fall on the cathode surface of a photocell, the stopping potentials of 1.2V and 0.57V respectively are required to stop photoelectric current. Calculate the Planck's constant.**

Uttarakhand Board-2019

Section-D (Case-Based Questions)

95. **What is photoelectric effect? Explain the variation of photoelectric current with the–**

(a) Intensity of the incident light;
(b) frequency of the incident light.

Meghalaya Board-2013

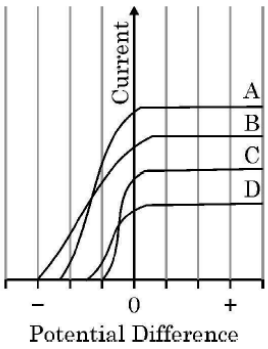
Section-E (Long Answer)

96. **Explain Hallwach's and Lenard's observations on photoelectric effect. Define:**

a. work function
b. Threshold frequency
c. Stopping potential

Karnataka Board-July, 2015

97. **(a) Figure shows the variation of photoelectric current measured in a photo cell circuit as a function of the potential difference between the plates of the photo cell when light beams A, B, C and D of different wavelengths are incident on the photo cell. Examine the given figure and answer the following questions :**



(i) Which light beam has the highest frequency and why ?
(ii) Which light beam has the longest wavelength and why ?
Which light beam ejects photo electrons with maximum momentum and why ?

OR

(b) What is the effect on threshold frequency and stopping potential on increasing the frequency of incident beam of light? Justify your answer.

CBSE-2023

98. **Write the experimental observations of Photoelectric effect.**

Karnataka Board-March, 2016
Karnataka Board-July, 2020

II. Einstein Photoelectric Equation and Work Function

Section-A (Multiple Choice Questions)

99. **Which one of the following metals does not exhibit emission of electrons from its surface when irradiated by visible light ?**

(a) Rubidium (b) Sodium
(c) Cadmium (d) Caesium

CBSE-2023

Ans. (c) :

100. **In an experiment on photoelectric effect, the intensity incident radiation is increased, keeping the frequency v the same. The number of photoelectrons emitted will :**

(a) increase
(b) decrease
(c) remain same
(d) depend on frequency

CBSE-2023

Ans. (a) :

101. **Light of frequency 6.4×10^{14} Hz is incident on a metal of work function 2.14 eV. The maximum kinetic energy of the emitted electrons is about :**

(a) 0.25 eV (b) 0.51 eV
(c) 1.02 eV (d) 0.10 eV

CBSE-2023

Ans. (*) :

102. **A light of frequency v is incident on a metal surface whose work function is W_0. The kinetic energy of emitted electron is K. If the frequency of the incident light is doubled then the kinetic energy of emitted electron will be**

(a) 2K (b) more than 2K
(c) between K and 2K (d) less than K

CBSE-2023

Ans. (b) :

103. **Which of the following metals has minimum work function ?**

(a) Iron (b) Copper
(c) Barium (d) Sodium

Jharkhand Board-2023

Ans. (c) :

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104. Work function of ——— is the lowest.
(a) Platinum (b) Caesium
(c) Nickel (d) Copper
Gujarat Board- March, 2020

Ans. (b) :

105. The work function of a photoelectric material is 3·3 eV. The threshold frequency will be equal to
(a) 8×10^{14} Hz (b) 8×10^{10} Hz
(c) 5×10^{20} Hz (d) 4×10^{14} Hz.
Tamil Nadu Board-2011

Ans. (a) :

106. A light of wavelength 500 nm is incident on a sensitive plate of photoelectric work function 1.235 eV. The kinetic energy of the photo electrons emitted is: (Take $h = 6.6 \times 10^{-34}$ Js)
(a) 1.16 eV (b) 0.58 eV
(c) 2.48 eV (d) 1.24 eV
Tamil Nadu Board-2023

Ans. (d) :

107. The work function of a photoelectric is 6.626×10^{-19}J. The threshold frequency is :
(a) 1×10^{15} Hz (b) 10×10^{-19} Hz
(c) 1×10^{-15} Hz (d) 10×10^{19} Hz
Tamil Nadu Board-2016

Ans. (a) :

108. Which of the following stopping potential required is minimum?
(a) Blue (b) Red
(c) Yellow (d) Green
Haryana Board-2017, 2016, 2018

Ans. (b) :

109. Variation of stopping potential V_0 with frequency (ν) of incident radiation for a given photosensitive material is straight line. [frequency (ν) of incident radiation is greater than threshold frequency (ν)]. The slope of this line is ___.
(a) $\frac{h}{e}$ (b) $\frac{h}{\nu}$
(c) $\frac{\phi_0}{h}$ (d) $\frac{e}{V_0}$
Gujarat Board-2023

Ans. (a) :

110. In a photoelectric experiment graph is plotted between stopping potential V_s and frequency of incident light ν. A straight line is obtained which makes angle θ with ν-axis. If the work function of the surface is ϕ, tan θ is given by
(a) $\frac{h}{e}$ (b) $\frac{e}{h}$
(c) $-\frac{\phi}{e}$ (d) $\frac{eh}{\phi}$
UP Board-2017

Ans. (a) :

111. If 'h' represents Planck's constant, 'c' the velocity of light and $\bar{v}$ is Wave number, then the unit of $h c \bar{v}$ is
(a) Newton (b) Watt
(c) Electron Volt (d) Pascal
Kerala Board-2017

Ans. (c) :

112. The energy of a photon of wavelength λ is-
(a) hc λ (b) $\frac{hc}{\lambda}$
(c) $\frac{h\lambda}{c}$ (d) $\frac{\lambda}{hc}$
Bihar Board-2019
CBSC-2023
Meghalaya Board -2021

Ans. (b) :

113. Work function of sodium is
(a) 2.75 eV (b) 1.75 eV
(c) 2.57 eV (d) 1.57 eV
Bihar Board-2021

Ans. (c) :

114. Energy of photon is
(a) $\frac{h\nu}{c}$ (b) $\frac{h}{cv}$
(c) $\frac{c}{h\nu}$ (d) hν
Bihar Board-2021

Ans. (d) :

115. For same wavelength of electron and photon which will be the same ?
(a) velocity
(b) energy
(c) momentum
(d) angular momentum
Bihar Board-2022, 2023

Ans. (c) :

Section-B (Very Short Answer)

116. For photo electric effect explain effect of frequency of incident radiation on stopping potential.

117. What is work function?
AP Board-2022

118. Assume that the frequency of the radiation incident on a metal plate is greater than its threshold frequency. If the frequency of the incident radiation is doubled. How will the following change?
(a) Kinetic energy of electrons
(b) photoelectric current
Manipur Board-2022

119. Define :
(a) Threshold frequency
(b) Photoelectric work function
Maharashtra Board-2020

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120. The threshold frequencies of two photosensitive surfaces are v_1 and v_2, respectively. What is the ratio of the velocities of the photoelectrons emitted from these surfaces when light of frequency v is incident on them and photoemission occurs?

CBSE-2020

121. In photoelectric emission when the frequency of incident radiation is doubled, will be maximum kinetic energy of photoelectrons also be doubled ? Justify your answer.

CBSE-2019

122. Give Einstein's equation for photoelectric emission. What do symbol stands for ?

Odisha Board-2022
ISC-2004

123. How can the work function of tungsten be increased ?

ISC-2007

124. Name the phenomena or experiment which proves particle nature of electromagnetic radiations.

ISC-2013

125. Threshold frequency of a certain metal for photoelectric emission is 5×10^{14} Hz. Calculate its work function.

ISC-2012, 2009

126. Two metals A and B have work functions 4 eV and 6 eV, respectively. Which metal has lower threshold wavelength for photoelectric effect ?

ISC-2016

127. What effect of frequency of incident radiation on stopping potential.

MP Board-2020

128. Write down the definition of work function.

MP Board-2020
UP Board -2020

129. Establish Einstein's relation $\frac{1}{2}mu^2 = hv - hv_0$ with respect to photoelectric emission.

MP Board-2018

130. The work function of a metal is 0.1 eV. Calculate the threshold frequency for photo-electric emission.

MP Board-2014

131. Define the following-
Thermionic Emission and Dual Nature of Radiation.

MP Board-2015

132. The number of photo electrons emitted per second depend on the ..... of incident radiation.

MP Board-2015

133. Define the following:
Threshold frequency and work function.

MP Board-2014

134. Define work function of a metal. Mention its unit.

Tamil Nadu Board-2022

135. Define the following in photoelectric effect phenomenon
(i) work function
(ii) stopping potential

Rajasthan Board-2023
Odisha Board -2023
Maharashtra Board-2019
ISC Board-2008, 2001

136. If the work function of caesium metal is 2.14 eV then find its threshold frequency in Hz.

Rajasthan Board-2023
Assam Board-2014

137. By writing Einstein's photoelectric equation, explain any two observations related to photoelectric effect.

Rajasthan Board-2022

138. Name any two factor on which the work function of a metal depends.

Nagaland Board-2021

139. (b) Derive the equation $v_o = \left(\frac{h}{e}\right)v - \frac{\Phi_o}{e}$ from Einstein's photoelectric equation.

Nagaland Board-2020

140. Define threshold frequency for photo-electric emission. 2

Haryana Board-2018

141. Define photoelectric emission and write Einstein's photoelectric equation.

Haryana Board-2017

142. Write and explain Einstein's equation of the photoelectric effect?

Jharkhand Board-2023

143. The planck's constant is h and frequency of a photon is v then write the formula for Einstein's photo electric equation.

MP Board-2015

144. The work function of a metal is 0.1 eV. Calculate the threshold frequency for photoelectric emission.

MP Board-2018

145. Explain the photoelectric effect bases on Einstein equation.

Chhattisgarh Board-2021

146. When radiations of frequency 5.6×10^{14} Hz are incident on a material photoelectrons are released from it with zero kinetic energy. Calculate the work function of the material. (Planck constant = 6.6×10^{-34} JS)

NIOS-2017

147. Explain with the help of Einsten's photo electric equation any two observed features in photoelectric effect which cannot be explained by wave theory.

CBSE-2019

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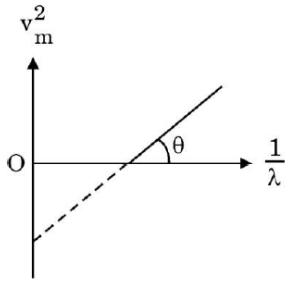
148. The figure shows V_m^2 versus $\frac{1}{\lambda}$ graph for photoelectrons emitted from a surface where v_m is the maximum speed of electrons and λ is the wavelength of incident radiation. Using this graph and Einstein's photoelectric equation, obtain the expression for Planck's constant and work function of the surface



CBSE-2023

149. The threshold wavelength for two photosensitive surfaces A and B are λ_1 and λ_2, respectively. What is the ratio of the work functions of the two surfaces?

CBSE-2020

150. Find its threshold frequency.

Assam Board-2014

151. Calculate the energy equivalent of 1 kg of a substance.

Assam Board-2023

152. What is the dimension of Plank's Constant?

Assam Board-2017

153. What is reverse Saturation Current?

Assam Board-2015

154. The threshold frequency of a material is 2×10^{14} Hz. What is its work function ?

Meghalaya Board-2021

155. Two metals X and Y have work functions 2 eV and 5 eV respectively. Which metal will emit electrons when irradiated with the light of wavelength 400 nm and why ?

Meghalaya Board-2017

156. Define the term 'stopping potential' in relation to photoelectric effect.

OR

Why does photoelectric emission not take place it the frequency of incident radiation is less than the threshold value?

Meghalaya Board-2023

157. The photoelectric work function for a metal surface is 3.84×10^{-19}J. If the light of wavelength 5000 Å is incident on the surface of the metal, will there be photoelectric emission?

Maharashtra Board-2020

158. Write the relation between the work function (w) and threshold frequency (v_0) in photoelectric effect.

Odisha Board-2020

159. What are the applications of microwaves ?

Telangana Board-2015

160. What is work function?

Telangana Board-2018, 2015

161. Define (i) photoelectric work function (ii) electron volt (eV)

Karnataka Board-July, 2016

162. Write Einstein's mass-energy relation.

Uttarakhand Board-2020

163. Mention two incidents which confirm the particle nature of light.

Uttarakhand Board-2023

Section-C (Short Answer)

164. The work function of ceasium metal is 2.14eV. When light of frequency 6×10^{14} Hz is incident on the metal surface, photo emission of electrons occurs. Find

a) Energy of incident photons

b) Maximum kinetic energy of photoelectrons

Given planks constant = h = 6.63×10^{-34}Js. 1eV = 1.6×10^{-19} J

Karnataka Board-July, 2014

165. (a) Write two main observations of photoelectric effect experiment which could only be explained by Einstein photoelectric equation.

(b) Draw a graph showing variation of photocurrent with the anode potential of a photocell.

CBSE-2020

166. Light of wavelength λ is incident on a metallic surface of threshold wavelength $\lambda_0(\lambda < \lambda_0)$ and photoelectrons are emitted.

(a) Write the expression for stopping potential (V_s) for the emitted electrons.

(b) Draw the graph between V_s and $\frac{1}{\lambda}$

(c) How can one use this graph to determine the value of planck's constant and work function of the metal ?

CBSE-2020

167. The maximum kinetic energy of the photoelectrons emitted is doubled when the wavelength of light incident on the photosensitive surface changes from λ_1 to λ_1 . Deduce expressions for the threshold wavelength and work function for the metal surface in terms of λ_1 and λ_2.

CBSE-2020

168. Ultra – violet light of wavelength 200 nm from a source is incident on a metal surface. If the stopping potential is –2.5 V, (a) calculate the work function of the metal, and (b) How would the surface respond to a high intensity red light of wavelength 6328 Å produced by a laser ?

CBSE-2022

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169. What is photoelectric effect ? With the help of a suitable graph show the variation of photocurrent with

(i) the intensity of incident radiation.

(ii) the voltage applied between cathode and anode.

(iii) the frequency of incident radiation.

ISC-2004

170. Photoelectrons are emitted from a metal surface when UV-light of wavelength λ = 300 nm is incident on it. The minimum negative potential required to stop the emission of electrons is 0.54 V. Calculate

(i) the energy of the incident photons.

(ii) the maximum kinetic energy of the photoelectrons emitted.

(iii) the work function of the metal.

ISC-2003, 2000

171. What do you understand by work function of a metal? Describe Einstein's photo-electric equation.

Uttarakhand Board-2020

172. Establish Einstein's equation

$\frac{1}{2}mv_{max}^2 = h(v - v_0)$ **related to the photoelectric effect. Explain the laws of photoelectric effect on the basis of this equation.**

Uttarakhand Board-2023

173. The work function of Caesium metal is 2.14 eV. If light of frequency 6×10^{14} Hz is incident on the metal surface, then what will be maximum kinetic energy of the emitted electrons?

Uttarakhand Board-2022

174. When the energy of the incident radiation is increased by 20%, the maximum kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5 eV to 0.8 eV. Find the work function of the metal.

Goa Board-2019

175. (a) Write Einstein's photoelectric equation.

(b) Using this equation show that, "photoelectric emission is not possible if the frequency of incident radiation is less than threshold frequency".

Kerala Board-2021

176. (a) Use Einstein's photoelectric equation to depict the variation of the maximum kinetic energy (E_k) of electrons emitted, with the frequency (v) of the incident radiation.

(b) A photosensitive surface is illuminated with a beam of (i) yellow light, and (ii) red light, both of the same intensity. In which case will

(I) photoelectrons have more E_k ?

(II) more numbers of electrons be emitted ? Justify your answer in each case.

CBSE-2022

177. Ultraviolet light of wavelength 300 nm from a 100 W mercury source irradiates a photocell made up of a metallic surface. If the stopping potential is 1.5 V, then calculate

(a) the work function of the metal in eV, and

(b) the number of photoelectrons emitted per second.

Assume the 60% of the photons emitted from the source cause photoelectric emission in this case.

CBSE-2020

178. Light of wavelength 2000 Å is incident on a metal surface of work function 4.2 eV in an experiment on photoelectric effect.

(a) Find the maximum kinetic energy (in eV) of ejected photoelectrons.

(b) If the intensity of light is doubled, find the change in stopping potential.

CBSE-2020

179. The work function of a metal is 2.31 eV. Photoelectric emission occurs when light of frequency 6.4×10^{14} Hz is incident on the metal surface. Calculate : (i) the energy of the incident radiation, (ii) the maximum kinetic energy of the emitted electron and (iii) the stopping potential of the surface.

CBSE-2022

180. The work function of a metal is 4.50 eV. Find the frequency of light to be used to eject electrons from the metal surface with a maximum kinetic energy of 6.06×10^{-19} J.

CBSE-2022

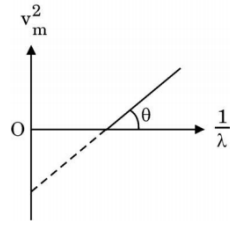
181. Plot a graph showing the variation of photo electric current, as a function of anode potential for two light beams having the same frequency but different intensities I_1 and I_2 ($I_1 > I_2$). Mention its important features.

CBSE-2023

182. How would the stopping potential for a given photosensitive surface change if (i) the frequency of the incident radiation were increased? and (ii) the intensity of incident radiation were decreased? Justify your answer.

CBSE-2023

183. The figure shows v_m^2 versus $\frac{1}{\lambda}$ graph for photoelectrons emitted from a surface where v_m is the maximum speed of electrons and λ is the wavelength of incident radiation. Using this graph and Einstein's photoelectric equation, obtain the expression for Planck's constant and work function of the surface.



CBSE-2023

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184. When light of frequency v_1 is incident on a photosensitive surface, the stopping potential is V_1. If the frequency of incident radiation becomes $\frac{v_1}{2}$, the stopping potential changes to V_2. Find out the expression for the threshold frequency for the surface in terms of V_1 and V_2. If the frequency of incident radiation is doubled, will the maximum kinetic energy of the photoelectrons also be doubled? Give reason.

CBSE-2019

185. Derive Einstein's photoelectric equation.

Tamil Nadu Board-2018

186. Derive Einstein's photoelectric equations.

J&K Board-2022, 2017
Nagaland Board-2017

187. Write Einstein's photoelectric equation. Define the threshold frequency υ_0 and stopping potential V_0.

Haryana Board-2018

188. Draw a graph between potential energy of a pair of nucleons and separation between them. Also write its main features.

Haryana Board-2018

189. Using Einstein's photoelectric equation, explain effect of frequency of incident radiation on stopping potential.

Haryana Board-2018

190. Calculate the wavelength of light incident on a material of work function 2.0 eV, if stopping potential is 0.50 V.

Haryana Board-2018, 2016

191. Monochromatic light of wavelength 3000Å is incident normally on a surface of area 4 cm^2. If the intensity of light is $150\frac{mW}{m^2}$, find the number of photons being incident on this surface in one second.
($h = 6.625\times10^{-34}$ J.s, $C = 3\times10^8$ ms^{-1})

Gujarat Board- May, 2021

192. The work function of cesium is 2.14 eV. Find
(a) the threshold frequency of cesium, and
(b) the wavelength of the incident light if the photo current is brought to zero by a stopping potential of 0.86 V.

Gujarat Board-2023

193. The wavelength of light incident on a photosensitive surface decreases from 6000 Å to 5000 Å and maximum kinetic energy of emitted electrons increases from 0.46 eV to 0.875 eV. Calculate the work function of the surface, Planck's constant and threshold wavelength.

UP Board-2021

194. (i) Write Einstein's photoelectric equation.
(ii) If the frequency of the incident radiation is increased from 4×10^{15} Hz to 8×10^{15} Hz, by how much will the stopping potential for a given photosensitive surface go up ?

ISC-2014

195. How does Einstein's photoelectric equation explain the emission of electrons from a metal surface ? Explain briefly.
Plot the variation of photocurrent with :
(a) collector plate potential for different intensity of incident radiation, and
(b) intensity of incident radiation.

CBSE-2023

196. Albert Einstein, the great physist proposed a clear picture to explain photoelectric effect.
(a) Explain Einstein's photo electric equation.
(b) Name the quanta of light.

Kerala Board-2014

197. A metal has a threshold wavelength of 6000 Å. Calculate -
(a) threshold frequency
(b) the work function.

Meghalaya Board-2021

198. Define work function and threshold frequency of metal. Write Einstein's photoelectric equation in terms of stopping potential, frequency of incident radiation and threshold frequency of a metal.

Meghalaya Board-2018

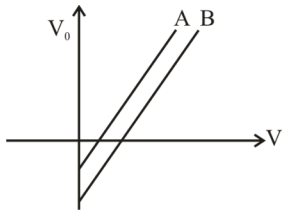
199. The work function for a metal surface is 2.2eV.
If light of wavelength 5000 Å is incident on the surface of the metal, find the threshold frequency and incident frequency. Will there be an emission of photoelectrons or not?
($c = 3 \times 10^8$ m/s, 1 eV = 1.6×10^{-19} j, $h = 6.63 \times 10^{-34}$ J.s.)

Maharashtra Board-2018

200. (a) In a photoelectric emission:
(i) Stopping potential is constants
(ii) Maximum kinetic energy of the emitted photoelectrons is constant.
In each of the case, which quantity of the incident radiation is kept constant?
(b) Why are alkali metals most suited as photo-sensitive materials? Or
(a) An electron and a proton have either:
(i) same kinetic energy or
(ii) same speed
In each case, which particle has the shorter de Broglie wavelength?
(b) Why the bigger objects in daily life not show wave-like properties?

Goa Board-2023

201.



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(a) A graph of stopping potential against incident frequency for tow photo sensitive metals A and B is shown in the figure.

(b) Write the expression for the maximum velocity of a photo electron, in terms of its cut off voltage V_0

Goa Board-2018

202. What is Einstein's explanation of photoelectric effect?

J&K Board-2011

203. Define work function. Write Einstein's photoelectric equation and explain the terms.

Karnataka Board-March, 2020

Section-D (Long Answer)

204. Photoelectric emission occurs when a surface is irradiated with the radiation of frequency (i) v_1, and (ii) v_2. The maximum kinetic energy of the electrons emitted in the two cases are K and 2K respectively. Obtain the expression for the threshold frequency for the surface.

CBSE-2022

205. The work function of sodium is 2.28 eV.

(i) What is the minimum energy for a quantum of radiation to cause photoelectric emission from sodium surface?

(ii) Calculate the wavelength of this radiation.

ISC-2009

206. The threshold wavelength of tungsten is 2400 Å when tungsten is illuminated with light of wavelength 1600 Å. Find

(i) work function

(ii) maximum KE of emitted electron.

(iii) stopping potential.

ISC-2005

207. Plot a labelled graph of (V_s), where V_s is stopping of photoelectrons versus frequency v of incident radiation. How will you use this graph to determine the value of Planck's constant? Explain

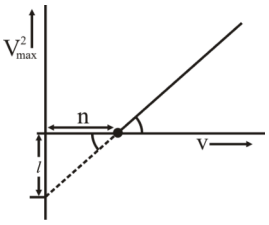
ISC-2017, 2009

208. Write Einstein's photoelectric equation using the quantum picture of radiation.

Explain briefly the three characteristic features observed in photoelectric effect which can be explained by Einstein's equation and not by the wave theory of light.

CBSE-2019

209. When a given photosensitive material is irradiated with light of frequency ν, the maximum speed of the emitted photoelectrons equals V_{max}. The graph shown in the figure gives a plot of V^2_{max} varying with frequency ν.



Obtain an expression for

(a) Planck's constant, and

(b) The work function of the given photosensitive material in terms of the parameters '*l*' 'n' and the mass 'm' of the electron.

(c) How is threshold frequency determined from the plot?

(d) CBSE-2019

210. (a) Plot a graph to show the variation of stopping potential with frequency of incident radiation in relation to photoelectric effect.

(b) Use Einstein's photoelectric equation to show how from this graph,

(i) Threshold frequency, and

(ii) Planck's constant can be determined.

CBSE-2019

211. (a) How does one explain the emission of electrons from a photosensitive surface with the help of Einstein's photoelectric equation?

(b) Work function of aluminum is 4.2 eV. If two photons each of energy 2.5 eV are incident on its surface, will the emission of electrons take place ? Justify your answer.

(c) The stopping potential in an experiment on photoelectric effect is 1.5 V. What is the maximum kinetic energy of the photoelectrons emitted ? Calculate in Joules.

CBSE-2019

212. (i) Increase in the intensity of the radiation causing photo-electric emission from a surface, does not affect the maximum K.E. of the photo electrons. Explain.

(ii) The photon emitted during the de-excitation from the first excited level to the ground state of hydrogen atom is used to irradiate a photo cathode in which stopping potential is 5 V. Calculate the work function of the cathode used.

CBSE-2023

213. Which characteristics of photoelectric effect are not explained by the wave nature of light. Explain Einstein's explanation.

Gujarat Board-March, 2022

214. The work function of caesium metal is 2.14 eV. When light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. ($h = 6.6 \times 10^{-34}$ js)

(a) Define work function.

(b) Calculate the maximum kinetic energy of the emitted electrons.

(c) Calculate the stopping potential.

Kerala Board-2020

215. Describe the characteristics of photoelectric effect. Establish Einstein's photoelectric equation and show how it explains the characteristic.

Odisha Board-2023

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216. Write Einstein's equation of photoelectric effect. Give Einstein's explanation of photoelectric effect.

Karnataka Board-March, 2015
Karnataka Board-July, 2014

217. Light of frequency 8.41 x 10^{14} Hz is incident on a metal surface. Electrons with their maximum speed of 7.5 × 10^5 ms^{-1} are ejected from the surface Calculate the threshold frequency for photo emission of electrons. Also find the work function of the metal in electron volt (eV).

Given Planck's constant h = 6.625 × 10^{-34} JS and mass of the electron 9.1 × 10^{-31} Kg.

Karnataka Board-July, 2018

III. Particle Nature of Light : The Photon

Section-A (Multiple Choice Questions)

218. Photons of energy 3.2 eV are incident on a photosensitive surface. If the stopping potential for the emitted electrons is 1.5 V, the work function for the surface is :

(a) 1.5 eV (b) 1.7 eV
(c) 3.2 eV (d) 4.7 eV

CBSE-2023

Ans. (b) :

219. The momentum of a photon of wavelength λ is :

(a) $\frac{h\lambda}{c^2}$ (b) $\frac{h\lambda}{c}$
(c) $\frac{h}{\lambda}$ (d) zero

CBSE-2023

Ans. (c) :

220. The energy of a photon of wavelength 663 nm is

(a) 6.64 × 10^{-20} J (b) 5.18 × 10^{-19} J
(c) 3.0 × 10^{-19} J (d) 2.0 × 10^{-20} J

CBSE-2023

Ans. (c) :

221. In an experiment, photons of energy 7.5 eV are incident on a metal surface. Electrons emitted from the metal surface are stopped by an electrode at a potential of – 4.5 V w.r.t. the metal. The work function of the metal is :

(a) 3.0 eV (b) 4.5 eV
(c) 7.5 eV (d) 12.0 eV

CBSE-2023

Ans. (a) :

222. A photon of energy 7 eV is incident on a metal surface having the work function of 3.75 eV. The stopping potential is :

(a) 1.75 eV (b) 2.45 eV
(c) 3.25 eV (d) 3.75 eV

CBSE-2023

Ans. (c) :

223. Photons of energies 1 eV and 2 eV are successively incident on a metallic surface of work function 0.5 eV. The ratio of kinetic energy of most energetic photoelectroms in the two cases will be

(a) 1 : 2 (b) 1 : 1
(c) 1 : 3 (d) 1 : 4

CBSE-2020

Ans. (c) :

224. E, c and v represent the energy, velocity and frequency of a photon. Which of the following represents its wavelength?

(a) $\frac{hv}{c^2}$ **(b)** hv
(c) $\frac{hc}{E}$ **(d)** $\frac{hv}{c}$

CBSE-2023

Ans. (c) :

225. The wavelength of a photon is 5000 Å. Its momentum will be-

(a) 1.3 × 10^{-27} kg. × meter/sec
(b) 1.5 × 10^{-27} kg. × meter/sec
(c) 2.32 × 10^{-27} kg. × meter/sec
(d) 5 × 10^{-27} kg. × meter/sec

MP Board-2017

Ans. (a) :

226. Photons are _____electrically.

(a) Neutral
(b) Negatively charged
(c) Positively charged
(d) Some time positively charged and some time negatively charged

Gujarat Board-March, 2022

Ans. (a) :

227. What is the energy formed by the Photon carrying frequency of 6.0 × 10^{14} Hz.

(a) 3.98 × 10^{-19} J (b) 1.99 × 10^{-19} J
(c) 3.98 × 10^{-17} J (d) 1.99 × 10^{-17} J

Gujarat Board- July, 2022

Ans. (a) :

228. The quantum of energy 4000 hν contains _____photons.

(a) 8000 (b) 2000
(c) 2400 (d) 4000

Gujarat Board- July, 2022

Ans. (d) :

229. The momentum of a photon of frequency v is :

(a) $\frac{h}{c}$ (b) hc
(c) hv (d) $\frac{hv}{c}$

Jharkhand Board-2020

Ans. (d) :

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230. Monochromatic light of frequency 6×10^{14} Hz is produced by laser. Each photon has an energy = ——J.

(a) 6×10^{14} (b) 4×10^{-19}
(c) 4×10^{-20} (d) 6×10^{-14}

Gujarat Board- March, 2020

Ans. (b) :

231. Photons of energy 1eV and 2.5eV successively illuminate a metal whose work function is 0.5eV. The ratio of maximum speed of emitted electron is ————.

(a) 3:1 (b) 2:1
(c) 1:2 (d) 1:3

Gujarat Board- May, 2021

Ans. (c) :

232. Mass of photon in motion is ——.

(a) hf (b) $\frac{h}{\lambda}$
(c) $\frac{c}{hf}$ (d) $\frac{hf}{c^2}$

Gujarat Board- May, 2021

Ans. (d) :

233. Energy of photon is E = hf and its momentum is P = $\frac{h}{\lambda}$, where λ is the wavelength of photon. With this assumption speed of light wave is ——.

(a) EP (b) $\frac{E}{P}$
(c) $\frac{P}{E}$ (d) $\left(\frac{E}{P}\right)^2$

Gujarat Board- May, 2021

Ans. (b) :

234. The energy of a photon of characteristic X-ray from a Coolidge tube comes from:

(a) the kinetic energy of the free electrons of the target
(b) the kinetic energy of the ions of the target
(c) the kinetic energy of the striking electron
(d) an atomic transition in the target

Tamil Nadu Board-2017

Ans. (d) :

235. A photon of wavelength 663 nm is incident on a metal surface. The work function of the metal is 1.50 eV. The maximum kinetic energy of the emitted photo electrons is

(a) 3.0×10^{-20} J (b) 6.0×10^{-20} J
(c) 4.5×10^{-20} J (d) 9.0×10^{-20} J

CBSE-2023

Ans. (b) :

236. In photoelectric effect, the momentum of incident photon of energy 3×10^{-19}J is :

(a) 9×10^{11} kgms^{-1} (b) Zero
(c) 10^{-27} kgms^{-1} (d) 3×10^{-11} kgms^{-1}

Tamil Nadu Board-2018

Ans. (c) :

Section-B (Very Short Answer)

237. Explain dual nature of matter and radiation

Odisha Board-2020

238. A monochromatic source of light operating at 200W emits 4×10^{20} photons/sec. Find the wavelength of light. Given h = 6.63×10^{-34} J-S C = 3×10^{8} m/s.

Assam Board-2015

239. A monochromatic source of light emits light of wavelength 198 nm. Calculate
(i) the energy of each photon.
(ii) the momentum of photons.

ISC-2011

240. What is the wavelength of a photon of energy $3{\cdot}3 \times 10^{-19}$ J?

CBSE-2020

241. In photon picture of light, what determines the intensity of light ?

CBSE-2022

242. Find number of photons in 6.62J of radiant energy of frequency 10^{12} Hz.
(Take h = 6.62×10^{-34} J-s)

NIOS-2019

243. Radiation power of 3.31 Watt is falling on a surface. If 20% of light is absorbed and remaining is reflected back, calculate number of photons reflected per second. Take the frequency of each photon 10^{12} Hz. and $h = 6.62\times10^{-34}$ J – s

NIOS-2019

244. Find the energy of a photon in eV having wavelength $\lambda = 5 \times 10^{-7}$ m.

UP Board-2020, 2021

245. Calculate the momentum of photon of green light of λ = 500 nm in SI unit.

ISC-2007

246. What is the momentum (p) of photon from ultraviolet light of wavelength λ = 332 nm.

ISC-2005

247. Calculate the momentum of a photon of energy 6×10^{-19} J.

ISC-2017

248. Define intensity of radiation based on photon picture of light.

CBSE-2019

249. Why is wave theory of electromagnetic radiation not able to explain photo electric effect? How does photon picture resolve this problem?

CBSE-2019

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250. Define the term " Intensity" in photon picture of electromagnetic radiation
CBSE-2019

251. What is the rest mass of photon?
Chhattisgarh Board-2020

252. Monochromatic light of frequency 6.0×10^{14} Hertz is produced by a laser. What is the energy of a photon in the light beam ? ($h = 6.63 \times 10^{-34}$JS)
MP Board-2019

253. Find energy of photon of wavelength 4000 $\mathring{A}$.
MP Board-2013

254. Which of the photons of red and blue light will have more energy?
Jharkhand Board-2023

255. Calculate the energy of photon in eV for a radiation of wavelength 5000 $\mathring{A}$.
($h=6.625\times10^{-34}$ Js, $c = 3\times10^{8}ms^{-1}$, $e=1.6\times10^{-19}C$).
Gujarat Board- March, 2019

256. Photons of energy 5eV are incident on a metallic block of work function 2.3 eV. Calculate the maximum kinetic energy of the photoelectrons emitted from the metal surface.
NIOS-2022

257. Photon is a quanta of light.
Who introduced the concept of photon?
Kerala Board-2013

258. Calculate the frequency associated with a photon of energy 3.3×10^{-20} J.
Meghalaya Board-2021

259. Green light ejects electron from a certain photo-sensitive surface, but yellow light does not. What will happen in case of red and violet light?
Meghalaya Board-2018

260. Photons of energy 3.55 eV each are incident on a metal surface whose work function is 1.9 eV. What is the maximum KE with which an electron is ejected from its surface?
Meghalaya Board-2015

261. What is the momentum and energy of a photon of frequency 1.5×10^{13} Hz? Take $h = 6.6 \times 10^{-34}$ Js and $c = 3 \times 10^{8}$ m/s.
J&K Board-2019

Section-C (Short Answer)

262. Name a phenomenon which illustrates the particle nature of light.
Punjab Board-2018

263. Explain the working of a Ruby Laser with the help of energy level diagram.
Tamil Nadu Board-2011

264. The energy flux of sunlight reaching the surface of the earth is 1.388×10^{3} W m^{-2}. How many photons (nearly) per square metre are incident on the Earth per second? The wavelength of the photon is 550 nm.
[$h = 6.625 \times 10^{-34}$ Js]
Gujarat Board- July, 2022

265. If the energy of a photon corresponding to wavelength 6000 $\mathring{A}$ is 9.92×10^{-19} joule, then what will be the energy of the photon corresponding to wavelength 4000 $\mathring{A}$?
Chhattisgarh Board-2022

266. (a) Calculate the energy and momentum of a photon in a monochromatic beam of wavelength 331.5 nm.
(b) How fast should a hydrogen atom travel in order to have the same momentum as that of the photon in part (a) ?
CBSE-2022

267. (a) Calculate the frequency of a photon of energy 6.5×10^{-19} J.
(b) Can this photon cause emission of an electron from the surface of Cs of work function 2.14 eV? If yes, what will be maximum kinetic energy of the photoelectron ?
CBSE-2022

I. Wave Nature of Matter (De-Broglie Relation) Section-A

(Multiple Choice Questions)

268. The de - Broglie wavelength of a ball of mass 120g moving with a speed of $20ms^{-1}$ is ____.
(a) 2.76×10^{-34} Å (b) 2.76×10^{-34} m
(c) 2.76×10^{-24} m (d) 2.76×10^{24} Å
Gujarat Board- August, 2020

Ans. (b) :

269. The uncertainty in position of a particle is same as it's de Broglie wavelength, uncertainty in its momentum is___.
(a) $\frac{2h}{3\lambda}$ (b) $\frac{h}{\lambda}$
(c) $\frac{\lambda}{h}$ (d) $\frac{3\lambda}{2h}$
Gujarat Board- March, 2019

Ans. (b) :

270. The ratio of de-Broglie wavelengths associated with two electrons accelerated by 25V and 36V is
(a) $\frac{25}{36}$ (b) $\frac{36}{25}$
(c) $\frac{5}{6}$ (d) $\frac{6}{5}$
Jharkhand Board-2023

Ans. (d) :

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271. An electron is accelerated through a potential V, its de-Broglie wavelength is λ. If accelerating voltage is decreased to V/2, its de-Broglie wavelength will become.

(a) 2λ (b) $\sqrt{2}\lambda$

(c) $\lambda/2$ (d) $\lambda/\sqrt{2}$

NIOS-2019

Ans. (a) :

272. Which of the following particle moving with same velocity has maximum de Broglie wavelength ?

(a) Electron (b) Proton

(c) Neutron (d) Alpha-particle

UP Board-2020

Ans. (a) :

273. The de Broglie wavelength of electron of energy 5000eV is:

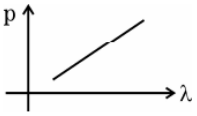
(a) 50 Å (b) 0.380 Å

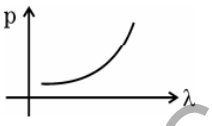
(c) 0.173 Å (d) 1.03 Å

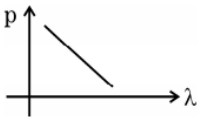
UP Board-2022

Ans. (c) :

274. Which of the following graphs correctly represents the variation of a particle momentum with its associated de-Broglie wavelength?

(a) 

(b) 

(c) 

(d)

CBSE-2023
CBSE-2020
ISC-2011

Ans. (d) :

275. A proton and an alpha particle have the same kinetic energy. The ratio of de Broglie wavelengths associated with the proton to that with the alpha particle is :

(a) 1 (b) 2

(c) $2\sqrt{2}$ (d) $\frac{1}{2}$

CBSE-2023

Ans. (c) :

276. The kinetic energy of a proton and that of an α-particle are 4eV and 1eV, respectively. The ratio of the de-Broglie wavelengths associated with them, will be

(a) 2 : 1 (b) 1 : 1

(c) 1 : 2 (d) 4 : 1

CBSE-2020

Ans. (b) :

277. An electron and a neutron have equal de Broglie wavelengths. It implies that they equal

(a) kinetic energy

(b) linear momentum

(c) linear velocity

(d) angular velocity

CBSE-2020

Ans. (b) :

278. If all particles are moving with the same speed, then the particle associated with the maximum de Broglie wavelength will be

(a) proton (b) α-particle

(c) neutron (d) β-particle

CBSE-2020

Ans. (d) :

279. A heavy particle initially at rest splits spontaneously into two particles of masses m_1 and m_2 having non-zero velocities. The ratio of de Broglie wavelengths associated with the particles is

(a) m_1/m_2 (b) m_2/m_1

(c) 1 (d) $\sqrt{m_2}/\sqrt{m_1}$

CBSE-2020

Ans. (c) :

280. De - Broglie wavelength associated with an electron, accelerated through a potential difference of 100 volt is

(a) 12.27 nm (b) 1.227 nm

(c) 0.1227 nm (d) 122.7 nm

Rajasthan Board-2023

Ans. (c) :

281. The de-Broglie wavelength associated with a moving particle is:

(a) directly proportional to its mass

(b) inversely proportional to its mass

(c) directly proportional to its energy

(d) directly proportional to its momentum

Haryana Board-2022

Ans. (d) :

282. The de Broglie wavelength associated with an electron accelerated through a potential difference of 100 V is:

(a) 12.70 nm (b) 5.227 nm

(c) 1.227 nm (d) 0.123 nm

Haryana Board-2018

Ans. (d) :

283. The de Broglie wavelength associated with an electron accelerated through a potential difference of 121 V is.

(a) 1.227 nm (b) 12.270 nm

(c) 0.112 nm (d) 11.200 nm

Haryana Board-2018

Ans. (c) :

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284. The de Broglie wavelength associated with an electron accelerated through a potential difference of 81 V is :

(a) 0.136 nm (b) 1.227 nm
(c) 1.36 nm (d) 12.27 nm

Haryana Board-2018

Ans. (a) :

285. The De-Broglie wavelength associated with a particle of momentum P is given as:

(a) p/h (b) h/p
(c) hp (d) None of these

Haryana Board-2018

Ans. (b) :

286. De-Broglie wavelength associated with an electron under a potential difference of 100 V is given by:

(a) 12.27 $\overset{0}{A}$ (b) 1.227 $\overset{0}{A}$
(c) 1 m (d) 1.227m

Haryana Board-2017

Ans. (b) :

287. De-Broglie wavelength associated with a particle of mass m, moving with velocity v is given by:

(a) mv (b) $\frac{mv}{h}$
(c) $\frac{h}{mv}$ (d) hmv

Haryana Board-2016

Ans. (c) :

Section-B (Very Short Answer)

288. State Heisenberg uncertainty principle.

AP Board-2023

289. Calculate the de Broglie wavelength associated with an electron moving with the speed of 5.4×10^6 ms^{-1} and a ball of mass 150g travelling at 30 ms^{-1}.
[$m_e = 9.1 \times 10^{-31}$ kg, $h = 6.625 \times 10^{-34}$ Js]

Gujarat Board- July, 2022

290. What is the meaning of matter-wave of Louis de Broglie? Deduce the relation for wavelength of de Broglie in terms of kinetic energy.

UP Board-2023

291. Find the de Broglie wavelength of an object of mass 1g moving with speed 0.01 m/s.

Odisha Board-2020

292. What is the conclusion of Davisson-Germer experiment on the nature of electron?

Karnataka Board-March, 2015, 2017

293. What is de-Broglie wavelength? Write expression for de-Broglie wavelength.

Uttarakhand Board-2020

294. What is the de Broglie wavelength associated with an electron, accelerated through a potential difference of 100 volts?

AP Board-2020, 2021

295. Write de Broglie's relation and explain the terms therein.

AP Board-2022

296. What is the de Broglie wavelength associated with an electron, accelerated through a potential difference of 100 Volts?

Gujarat Board- March, 2020

297. What are de-Broglie waves ? Calculate de-Broglie wavelength of a proton of momentum 2.55×10^{-22} kg m s^{-1}($h = 6.6 \times 10^{-34}$ Js).

Jharkhand Board-2018

298. What are de-Broglie waves? Establish the de-Broglie wavelength equation.

MP Board-2015

299. What is de-broglie matter wave. Write de-broglie wave relation.

MP Board-2023
Chattisgarh Board-2021

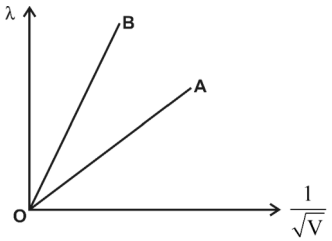
300. Define Matter Waves.

Chhattisgarh Board-2019

301. Establish de Broglie wave equation.

Chhattisgarh Board-2018

302. Two lines marked A and B in the figure given below show the plot of de Broglie wavelength λ vs. $\frac{1}{\sqrt{V}}$. where V is the accelerating potential for two nuclei ^2_1H and ^3_1H. (a) What does the slope of the lines represent and (b) which one of the two lines represents the particle of smaller mass? Give reason for your answer.



NIOS-2015

303. For an electron and a proton, travelling with same velocity which particle has larger de-Broglie wavelength ? Give reason.

UP Board-2017

304. Electron and proton are accelerated to the same potential. Which will have smaller

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momentum and greater de-Broglie wavelength associated?

UP Board-2021

305. Write down the formula for the de Broglie wavelength for a charged particle accelerated by potential difference of V.

UP Board-2022

306. (i) What is de-Broglie's hypothesis ?
(ii) What conclusion can be drawn from Davisson and Germer's experiment ?

ISC-2016

307. (i) State how de-Broglie wavelength (λ) of moving particles varies with their linear momentum (p).
(ii) State anyone phenomenon in which moving particles exhibit wave nature.

ISC-2015

308. Find the de-Broglie wavelength of electrons moving with a speed of 7×10^6 ms^{-1}.

ISC-2017

309. What is the relation between wavelength and momentum of moving electrons ?

ISC-2013

310. Name the phenomena or an experiment which proves wave nature of particle.

ISC-2013

311. de-Broglie wavelength of electrons of kinetic energy E is λ. What will be its value, if kinetic energy of electrons made 4E ?

ISC-2010

312. The wavelength of light from the spectral emission line of sodium is 590 nm. Find the kinetic energy at which the electron would have the same de-Broglie wavelength.

CBSE-2019

314. Plot a graph of de-Broglie wavelength associated with electron as a function of its kinetic energy.

CBSE-2019

315. Plot a graph of the de-Broglie wavelength associated with electron as a function of accelerating potential.

CBSE-2019

316. Plot a graph of the de-Broglie wavelength associated with a proton versus its momentum.

CBSE-2019

317. (a) Plot a graph showing variation of de Broglie wavelength (λ) associated with a charged particle of mass m, versus $\sqrt{V}$, where V is the accelerating potential.
(b) An electron, a proton and an alpha particle have the same kinetic energy. Which one has the shortest wavelength ?

CBSE-2019

318. How will the De Broglie wavelength associated with an electron be affected when the (i) velocity of the electron decreases? and (ii) accelerating potential is increased? Justify your answer.

CBSE-2023

319. What are matter waves ? A proton and an alpha particle are accelerated through the same potential difference. Find the ratio of the de Broglie wavelength associated with the proton to that with the alpha particle.

CBSE-2022

320. An electron is accelerated from rest through a potential difference of 100V. Find :
(i) the wavelength associated with
(ii) the momentum of and
(iii) the velocity required by, the electron.

CBSE-2022

321. The de-Broglie wavelength associated with an electron is 0.30 nm. Calculate : (a) the speed, and (b) the kinetic energy (in eV), of the electron.

CBSE-2022

322. If the kinetic energy of a particle is reduced to one - fourth $\left(\frac{1}{4}\right)$ of its initial value, how many times will the de Broglie wavelength associated with it become?

CBSE-2020

323. The de Brogli wavelengths associated with an electron and a proton are equal . Prove that the kinetic energy of the electron is greater than that of the proton.

CBSE-2020

324. A proton and an electron have equal speed. Find the ration of de Broglie wavelengths associated with them.

CBSE-2020

325. If λ_p and λ_α be the wavelength of de Broglie waves for a proton and an alpha particle then which of the following is correct?
(i) $\lambda_p = \lambda_\alpha$
(ii) $\lambda_p > \lambda_\alpha$
(iii) $\lambda_p < \lambda_\alpha$

Assam Board-2023

326. Derive an expression for the De-Broglie wavelength.

J&K Board-2014

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327. What is the de-Broglie wavelength of an electron beam accelerated through a potential difference of 25V?

Punjab Board-2018

328. Derive an expression for de-Broglie wavelength 'γ' of an election when accelerated through a potential difference of 'V' volts.

J&K Board-2018

329. Calculate de Broglie wavelength of mass of 1 g moving with velocity of 10^3 m/s.

J&K Board-2017

330. Derive de-Broglie wave equation for material particles.

J&K Board-2016

331. Derive an expression for the De-Brogue wavelength.

J&K Board-2015

332. Show that the De-Broglie wavelength of an electron of energy E is given by the relation $\gamma = \frac{h}{\sqrt{2mE}}$

J&K Board-2012

333. Calculate the de Broglie wavelength associated with an electron, accelerated through a potential difference of 100 V.

Rajasthan Board-2022

334. (a) Derive the relation $\lambda = \frac{h}{p}$ where the symbols have their usual meanings.

Nagaland Board-2020

335. Write the equation for the wavelength of de Broglie wave associated with a moving particle.

Kerala Board-2021

336. Calculate the de-Broglie wavelength of an electron moving with one fifth of the speed of light. Neglect relativistic effects. (h = 6.63 × 10–34 J.s, c = 3 × 10^8 m/s, mass of electron = 9 × 10^{-31} kg)

Maharashtra Board-2018

337. An electron is accelerated through a potential difference of 100 volt. Calculate de-Broglie wavelength in nm.

Maharashtra Board-2023

338. Calculate the de Broglie wavelength of a particle of mass 10g moving with speed 10m/s.

Odisha Board-2022

339. Draw a neat labelled circuit diagram of experimental arrangement for study of photoelectric effect.

Manipur Board-2022

340. An electron, an α particle and a proton have the same kinetic energy. Which of these particles has the shortest de Broglie wavelength ?

Telangana Board-2015

341. Write de Broglie's relation and explain the terms therein.

Telangana Board-2018

342. An alpha particle, a proton and an electron are moving with equal kinetic energy. Which one of these particles has the longest de Broglie wavelength? Give reason.

Karnataka Board-March, 2020

343. What is the conclusion of Davison and Germar experiment on the nature of electron?

Karnataka Board-March, 2015

344. Write the expression for de-Broglie wave length of electrons interms of electric potential and explain the terms used.

Karnataka Board-March, 2019

345. Write the expression for de-Broglie wavelength of a particle.

Karnataka Board-March, 2017

Karnataka Board-July, 2016

346. Calculate de Broglie wavelength associated with a speed of 2 × 10^5 ms^{-1}. Given h = 6.625 × 10^{-34} JS. m_e = 9.11 × 10^{-31} kg.

Karnataka Board-July, 2018

Section-C (Short Answer)

(b) Explain what is wave-particle duality

Odisha Board-2023

347. Explain de Broglie wavelength. Obtain an expression for de Broglie wavelength of wave associated with material particles.

The photoelectric work function for a metal is 4.2 eV. Find the threshold wavelength.

Maharashtra Board-2022

348. The kinetic energy of the electron orbiting in the first excited state o hydrogen atom is 3.4 eV. Determine the de-Broglie wavelength associated with it.

CBSE Foreign-2015

349. Define 'threshold frequency' and 'work function' of a metal. Show that de Broglie wavelength associated with a moving particle is $\lambda = \frac{h}{mv}$, where the symbols have their usual meanings.

Meghalaya Board-2015

350. Describe Davisson - Germer experiment which demonstrated the wave nature of electrons.

Tamil Nadu Board-2023

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351. **Find the ratio of the de Broglie wavelengths associated with an alpha particle and a proton, if both**

(a) have the same speeds,

(b) have the same kinetic energy,

(c) are accelerated through the same potential difference.

CBSE-2020, 2022

352. **Derive an expression for de-Broglie□s wavelength of matter waves.**

Tamil Nadu Board-2017, 2011

353. **a) For what Kinetic energy of a neutron, will the associated de - Broglie wavelength be 1.40×10^{-10}m?**

b) Find the de-Broglie wavelength of a neutron, in thermal equilibrium with matter, having an average Kinetic energy of $\frac{3}{2}K_B T$ at 300K.

[$K_B = 1.38 \times 10^{-23}$ SI unit]

Gujarat Board-March, 2022

354. **State de Broglie Hypothesis. Derive an expression for the de Broglie wavelength of an elementary particle of mass 'm' and charge 'q' and moving with a velocity 'v' after being accelerated through a potential difference 'V;.**

NIOS-2021

355. **Electrons initially at rest, passed through a potential difference of 2kV. Calculate their**

(i) final velocity.

(ii) de-Broglie wavelength.

ISC-2009

356. **(a) State briefly, with what purpose was Davisson and Germer experiment performed and what inference was drawn from this.**

(b) Obtain an expression for the ratio of the accelerating potentials required to accelerate a proton and an α-particle to have the same de-Broglie wavelength associated with them.

OR

(a) An electron and a proton are accelerated through the same potential. Which one of the two has

(i) greater value of de-Broglie wavelength associated with it, and

(ii) lesser momentum?

Justify your answer in each case.

(b) How is the momentum of a particle related with its de-Broglie wavelength? Show the variation on a graph.

CBSE-2019

357. **A photon and a proton have the same de-Broglie wavelength λ. Prove that the energy of the photon is (2nλc/h) times the kinetic energy of the proton.**

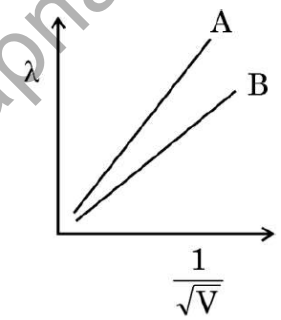
CBSE-2019

358. **(a) A particle of mass m and charge q is accelerated through a potential difference V. Plot a graph of de Broglie wavelength λ associated with it as a function of V.**

(b) Calculate the energy acquired by and de Broglie wavelength associated with, an electron accelerated through a potential difference of 400 V.

CBSE-2023

359. **The figure shows de Broglie wavelength (λ) for two particles A and B having same charges but different masses as a function of $\frac{1}{\sqrt{V}}$, where V is the potential through which the particles are accelerated.**



(i) Which of them is heavier and why ?

(ii) What does the slope of the line represent ?

(b) Calculate the momentum of an electron having de Broglie wavelength of 3·0 Å.

CBSE-2023

360. **Calculate the wavelength of de Broglie waves associated with a proton having $\left(\frac{500}{1.673}\right)$eV energy. How will the wavelength be affected for an alpha particle having the same energy ?**

CBSE-2023

361. **A particle is associated with a de Broglie wave of wavelength 1.2 nm. The kinetic energy of the particle is made four times. Calculate the new value of the wavelength of the wave.**

CBSE-2023

362. **(a) A proton and an α-particle are moving with the same speed. Which one of them has greater value of de Broglie wavelength associated with it ? Justify your answer.**

CBSE-2022

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363. A proton is accelerated through a potential difference V. After acceleration, the de Broglie wavelength associated with it is λ. If the proton is replaced by an alpha particle, then find the de Broglie wavelength associated with it if it were accelerated through the same potential difference V. What will be the momentum of the alpha particle ?

CBSE-2022

364. The wavelength of the waves associated with a particle having kinetic energy E is λ. How and by what factor should its kinetic energy be changed so that the wavelength becomes $\left(\frac{\lambda}{2}\right)$?

Also, find the ratio of the final to the initial velocity of the particle.

CBSE-2022

365. Describe an experiment which can be explained only by particle nature of light and not by wave nature. Explain the results of the experiment.

UP Board-2017

366. Derive an expression for the de-broglie wavelength associated with an electron accelerated from rest through a potential difference v.

Nagaland Board-2017

367. Explain Davisson Germen experiment with proper diagram. Prove that this experiment confirms the wave nature of electrons and de Broglie relation.

Gujarat Board-2023

368. State the laws of photoelectric effect. The light of intensity I and frequency ν is incident on a metal surface of work function W. How will the photoelectric current and the maximum kinetic energy of the photoelectron change when

(i) Intensity of the incident light is same but frequencies are different.

(ii) Frequency of the incident light is same but intensities are different.

UP Board-2020

369. The mass of an electron is $\frac{1}{1840}$ part of mass of a proton. When they are subjected to a uniform electric field, they start accelerating.

(a) Which of them will have large acceleration?

(b) If they start from rest and have the same De Broglie wavelength of 1 angstrom unit, then determine the ratio of their kinetic energies.

Kerala Board-2017

370. De Broglie proposed the wave nature of electrons suggesting matter waves. Find the momentum, speed and De-Broglie wavelength of an electron with kinetic energy of 120 eV.

Kerala Board-2014

371. The wavelength of matter waves is called de Broglie Wavelength.

(a) An α - particle, a proton and an electron having de Broglie wavelengths λ_α, λ_p and λ_e respectively are moving with the same momentum. Then

(i) $\lambda_\alpha > \lambda_p > \lambda_e$

(ii) $\lambda_p > \lambda_e > \lambda_\alpha$

(iii) $\lambda_\alpha = \lambda_p = \lambda_e$

(iv) $\lambda_p = \lambda_e \neq \lambda_\alpha$

(b) The de Broglie wavelength of a ball of mass 0.12 kg is 2.76×10^{-34} m. Calculate the speed of the ball.

[$h = 6.625 \times 10^{-34}$ Js]

Kerala Board-2016

372. (a) Derive de Broglie wave equation for material particles.

(b) Why does photoelectric emission not take place if the frequency of incident radiation is less than threshold frequency ?

Meghalaya Board-2019

373. Show that the de Broglie wavelength of an electron accelerated through a potential difference of V volts is $\lambda = \frac{h}{\sqrt{2meV}}$

Meghalaya Board-2018

374. A particle is moving three times as fast as an electron. The ratio of the de Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. Calculate the particle's mass and identify the particle.

Meghalaya Board-2023

375. What are matter waves? Write the expression for de-Broglei wavelength of a particle and explain the terms.

Karnataka Board-July, 2016

Section-D (Long Answer)

376. Deduce the expression for de Broglie wavelength of an electron accelerated through a potential difference of V volts. Hence find the de Broglie wavelength in Å associated with an electron accelerated under a potential difference of 100 volts.

Meghalaya Board-2014

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12. Atoms

I. Rutherford's Nuclear Model and Alpha particle scattering

Section-A (Multiple Choice Questions)

1. Which spectral line of hydrogen spectrum lies in visible region ?
(a) Balmer series (b) Brackett series
(c) Lyman series (d) Paschen series
Bihar Board-2022

Ans. (a) :

2. Paschen series of atomic spectrum of hydrogen gas lies in:
(a) Infrared region
(b) Ultraviolet region
(c) Visible region
(d) Partly in ultraviolet and partly in visible region
CBSE-2020

Ans. (a) :

3. The elliptical orbits of electron in the atom was proposed by:
(a) J.J. Thomson (b) Bohr
(c) Sommerfeld (d) de Broglie
Tamil Nadu Board-March, 2016

Ans. (c) :

4. The charge of cathode ray is :
(a) neutral (b) positive
(c) not defined (d) negative
Tamil Nadu Board-2022

Ans. (d) :

5. Obtain approximately the ratio of the nuclear radii of the gold isotope $^{197}_{79}Au$ and the silver isotope $^{107}_{47}Ag$.
(a) 1.68 (b) 1.35
(c) 1.84 (d) 1.23
Gujarat Board- August, 2020

Ans. (d) :

6. In case of head on collision, when the impact parameter is minimum, θ = —— rad (where θ = Scattering angle for α-particle)
(a) 0 (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{4}$ (d) π
Gujarat Board- March, 2020

Ans. (d) :

7. If a size of particle is a and wavelength of light is λ, for a << λ scattering is directly proportional to ———.
(a) λ^4 (b) $\frac{1}{\lambda^4}$
(c) λ^2 (d) $\frac{1}{\lambda^2}$
Gujarat Board- March, 2020

Ans. (b) :

8. If a body contains n_1 electrons and n_2 protons, the total amount of charge on the body is _____.
(a) $(n_2 + n_1)e$ (b) $\left(n_1^2 + n_2^2\right)e$
(c) $\left(n_1^2 - n_2^2\right)e$ (d) $(n_2 - n_1)e$
Gujarat Board-March, 2022

Ans. (d) :

9. The atomic number of an atom represents :
(a) number of neutrons in nucleus.
(b) total number of protons and electrons in the atom.
(c) number of protons in nucleus
(d) total number of protons and neutrons in nucleus.
CBSE-2023

Ans. (c) :

10. In the α-particle scattering experiment, the shape of the trajectory of the scattered α-particles depend upon:
(a) Only on impact parameter.
(b) Only on the source of α-particles.
(c) both impact parameter and source of α-particles.
(d) impact parameter and the screen material of the detector.
CBSE-2020

Ans. (a) :

11. Which of the following statements is not correct according to Rutherford model ?
(a) Most of the space inside an atom is empty
(b) The electrons revolve around the nucleus under the influence of coulomb force acting on them.
(c) Most part of the mass of the atom and its positive charge are concentrated at its center.
(d) The stability of atom was established by the model.
CBSE-2020

Ans. (d) :

12. The size of the atom in Thomson's model is ____ the atomic size in Rutherford's model.
(a) much greater than
(b) not different from
(c) much less than
Kerala Board-2020

Ans. (b) :

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13. **Which of the following is correct for intensity of scattered light (I) ?**

(a) $I \propto \frac{1}{\lambda}$ (b) $I \propto \frac{1}{\lambda^2}$

(c) $I \propto \frac{1}{\lambda^3}$ (d) $I \propto \frac{1}{\lambda^4}$

Bihar Board-2021

Ans. (d) :

14. **Which of the following is not a fundamental particle ?**

(a) Neutron (b) Proton

(c) α-particle (d) Electron

Bihar Board-2021

Ans. (d) :

15. **Which of the following is not accelerated by electric field ?**

(a) proton (b) neutron

(c) α-particle (d) electron

Bihar Board-2022

Ans. (b) :

Section-B (Very Short Answer)

16. **The Lyman series is in the _____region, but paschen and Brackett series are in the _____region.**

Assam Board-2023

17. **The term $a_0 = \frac{h^2\varepsilon_0}{\pi m e^2}$ is called**

(i) impact parameter

(ii) Bohr radius

(iii) activity

Assam Board-2023

18. **An alpha particle is accelerated through a potential difference of 100 V.**

Calculate :

(a) The speed acquired by the alpha particle, and

(b) The de-Broglie wavelength associated with it. (Take mass of alpha particle = 6.4×10^{-27}Kg)

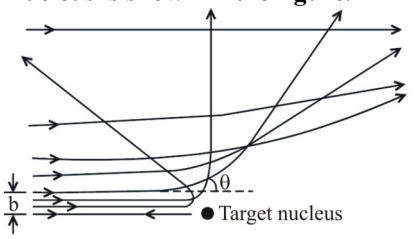
CBSE-2022

19. **Differentiate between 'distance of closest approach' and 'impact parameter'**

(ii) Determine the distance of closest approach when an alpha particle of kinetic energy 3.95 MeV approaches a nucleus of Z = 79, stops and reverses its directions.

CBSE-2023

20. **In Geiger-Marsden scattering experiment, the trajectory of α-particles in coulomb's field of a heavy nucleus is shown in the figure.**



(a) What do 'b' and 'θ' represent in the figure?

(b) What will be the value of 'b' for (i) θ = 0°, and (ii) θ = 180°?

CBSE-2020

21. **Write two drawbacks of Rutherford's atomic model.**

Rajasthan Board-2023

22. **Write two postulates of Rutherford's atomic model.**

NIOS-2022

23. **Explain atomic number and atomic mass number of the daughter element in the case of Alpha decay. Also write one example.**

Gujarat Board-March, 2022

24. **Write any five properties of α-rays (Alpha rays).**

Bihar Board-2021

J&K Board-2019

Tamil Nadu Board-2015

25. **Kinetic energy of an α-particle is 10^{-12} joule. It produces recoil scattering from the nucleus of gold (z = 79). What will be the distance of the closest approach of α-particle from the nucleus ?**

Given $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ Nm^2/C^2$

UP Board-2019

26. **In the Geiger-Marsden experiment, an α-particle of 5.12 MeV energy approaches a gold target (Z = 79), comes momentarily to rest and then reverses its direction. Find the distance of closest approach of α-particle to the target nucleus.**

CBSE-2020

27. **In the light of Rutherford's atom model discuss the stability of an atom and state its inability to explain line emission spectrum.**

Assam Board-2017

28. **What is an α-particle?**

Assam Board-2015

29. **What would happen, if the electrons in an atom were stationary ?**

Meghalaya Board-2021

30. **Why is the classical (Rutherford) model for an atom of electron orbiting around the nucleus not able to explain the atomic structure?**

CBSE-2023

CBSE Delhi-2012

ISC-2007

Section-C (Short Answer)

31. **Rutherford atom model is based on the classical concept that electrons are revolving around a central positive nucleus.**

(a) Mention the drawback of Rutherford atom model and how it is rectified in Bohr's atom model?

(b) From Bohr's theory obtain the de Broglie wavelength of an electron orbiting around the nucleus.

Kerala Board-2013

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32. An α-particle moving with initial kinetic energy K towards a nucleus of atomic number Z approaches a distance d at which it reverses its direction. Obtain the expression or the distance of closest approach d in terms of the kinetic energy of α-particle K.

CBSE All India-2016

33. Gamma rays and radio waves travel with the same velocity in free space. Distinguish between them in terms of their origin and the main application.

CBSE-2020

34. Define the distance of closest approach. An α-particle of kinetic energy K is bombarded on a thin gold foil. The distance of the closest approach is r. What will be the distance of closest approach for an α-particle of double the kinetic energy?
Write two important limitations of Rutherford nuclear model of the atom.

CBSE All India-2016

35. In a Geiger-Marsden experiment, calculate the distance of closest approach to the nucleus of Z = 80, when an α-particle of 8 MeV energy impinges on it before it comes to momentarily rest and reverses its direction.
How will the distance of closest approach be affected when the kinetic energy of the α-particle is doubled?

CBSE All India-2012

36. State one drawback of Rutherford's model of the atom. What modification of Rutherford's model were suggested by Bohr? State two limitations of Bohr's model of the atom.

Assam Board-2013

37. State the basic assumption of the Rutherford model of the atom. Explain in brief why this model cannot account for the stability of an atom?

CBSE Delhi-2010

38. Draw the diagram representing the schematic arrangement of Geiger – Marsden experimental set up for the alpha particle scattering.

Karnataka Board-July, 2018

39. Write down the results of Rutherford's α-particle scattering experiment. Which result nullifies the idea of uniform distribution of positive and negative and negative charges in an atom?

Assam Board-2017

40. Define the term – Distance of closet approach. How will it be affected, for an α- particle, if kinetic energy of the particle is doubled ?

CBSE-2022

41. Write shortcomings of Rutherford atomic model. Explain how these were overcome by the postulates of Bohr's atomic model.

CBSE-2020

42. What results do you expeed if α- particle scattering experiment is repeated using a thin sheet of hydrogen in place of a gold foil? Explain. (Hydrogen is a solid at temperature below 14K)

CBSE-2022

45. In Geiger-Marsden experiment, the distance of closest approach is considerably larger than the sum of the radii of the gold nucleus and the α-particle. Explain.

CBSE-2022

46. Draw a graph showing the variation of number of particles scattered (N) with the scattering angle θ in Geiger-Marsden experiment. Why only a small fraction of the particles are scattered at θ > 90° ? Mention two limitations of Rutherford nuclear model of an atom.

CBSE-2020, 2022

47. A deuteron and an alpha particle having same momentum are in turn allowed to pass through a magnetic field $\vec{B}$, acting normal to the direction of motion of the particles. Calculate the ratio of the radii of the circular paths described by them.

CBSE-2019

48. Mention Rutherford's nuclear atomic model. What are its drawbacks?

CBSE-2023
MP Board-2021
Jharkhand Board-2020
Telangana Board-2018

49. Write the relation between kinetic energy of α-particle and its distance of closest approach from nucleus in Rutherford's α-scattering experiment.

Haryana Board-2018

50. Describe J.J. Thomson's method for determining the specific charge of an electron.

Tamil Nadu Board-September, 2016

51. Describe J. J. Thomson's experiment for the determination of specific charge of an electron.

Tamil Nadu Board-2016

52. Describe in brief the Davisson-Germer experiment and write the facts inferred from it.

UP Board-2019

53. What conclusion was drawn by Rutherford based on Geiger Marsden's experiment on scattering of α-particles ?

ISC-2012

54. α-particle having KE of 1.8 MeV each are incident on a thin gold foil from a large distance. Applying the principle of conservation of energy, find the distance of closes approach of the α-particle from the gold nucleus. (Atomic number of gold = 79)

ISC-2009

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55. In the Rutherford scattering experiment, the distance of closest approach for an α-particle is d_0. If α-particle is replaced by a proton, how much kinetic energy in comparison to α-particle will be required to have the same distance of closest approach, d_0.

ISC-2005

56. A proton, a deuteron and an alpha particle, are accelerated through the same potential difference and then subjected to a uniform magnetic field $\vec{B}$, perpendicular to the direction of their motions. Compare (i) their kinetic energies, and (ii) if the radius of the circular path described by proton is 5 cm, determine the radii of the paths described by deuteron and alpha particle.

CBSE-2019

57. Explain briefly how Rutherford scattering of α-particle by a target nucleus can provide information on the size of the nucleus.

CBSE-2019

58. Differentiate between 'impact parameter' and 'distance of closest approach' in alpha particle scattering experiment. Identify, situations when impact parameter is (i) minimum, and (ii) very large.

CBSE-2022, 2023

59. Briefly explain Geiger-Marsden experiment. Show the variation of the number of particles scattered (N) with scattering angle (θ) in this experiment. What is the main conclusion that can be inferred from this plot ?

CBSE-2023

60. (a) In Geiger-Marsden experiment, calculate the distance of closest approach for an alpha particle with energy $2{\cdot}56 \times 10^{-12}$ J. Consider that the particle approaches gold nucleus (Z = 79) in head-on position.
(b) If the above experiment is repeated with a proton of the same energy, then what will be the value of the distance of closest approach ?

CBSE-2022

61. An α- particle is accelerated though a potential difference of 10 kV and moves along x - axis . It enters in region of uniform magnetic field $B = 2\times10^{-3}$ T acting along y- axis . Find the radius of its path. (Take mass of α-particle = 6.4×10^{-27} kg)

CBSE-2020

62. Explain, in brief, why Rutherford model cannot account for the stability of an atom.

CBSE Delhi-2010

63. In the study of Geiger-Marsden experiment on scattering of α-particles by a thin foil of gold, draw the trajectory of α-particles in the coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study.

CBSE All India-2015
ISC-2010
CBSE Foreign-2010

64. Explain briefly how Rutherford scattering of α-particle by a target nucleus can provide information on the size of the nucleus.

CBSE Delhi-2019

65. Explain Rutherford's α-ray scattering experiment and mention its significance

Odisha Board-2023

Section-D (Long Answer)

66. Draw a plot of α-particle scattering by a thin foil of gold to show the variation of the number of the scattered particles with scattering angle. Describe briefly how the large angle scattering explains the existence of the nucleus inside the atom. Explain with the help of impact parameter picture, how Rutherford scattering serves a powerful way to determine an upper limit of the size of the nucleus.

CBSE-2019

67. Explain the construction and working of a Geiger-Muller Counter.

Tamil Nadu Board-2017

68. Explain Raman scattering of light with the help of energy level diagram.

Tamil Nadu Board-2011

69. Describe α-particle scattering experiment. Write the Rutherford atomic model based on the results of this experiment.
Physical constants
Charge on electron = $6. \times10^{-19}$ Coulomb
Planck's constant h = 6.6×10^{-34}Joule-s
Speed of light c = 3×10^{8} m/s
$\mu_0 = 4\pi \times10^{-7}$ Tesla mA^{-1}
Mass of electron $m_e = 9.1 \times10^{-31}$ kg
$\varepsilon_0 = 8.86 \times10^{-12}$ C^2/Nm^2

UP Board-2022

70. Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?

CBSE All India-2014

II. Atomic Spectra

Section-A (Multiple Choice Questions)

71. White light is passed through sodium vapours contained in a thin walled glass flask and the transmitted light is examined with the help of spectrometer. The spectrum, so obtained is
(a) absorption spectrum
(b) solar spectrum
(c) band spectrum
(d) continuous spectrum

ISC-2012

Ans. (a) :

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72. The solar spectrum is
(a) continuous spectrum
(b) linear spectrum
(c) spectrum of black lines
(d) spectrum of black band

Bihar Board-2022

Ans. (b) :

73. Atomic spectrum should be:
(a) pure line spectrum
(b) emission band spectrum
(c) absorption line spectrum
(d) absorption band spectrum

Tamil Nadu Board-March, 2016

Ans. (a) :

74. The ratio of maximum frequency and minimum frequency of light emitted in Balmer series of hydrogen spectrum, in Bohr's model is
(a) $\frac{11}{9}$ (b) $\frac{9}{5}$
(c) $\frac{11}{7}$ (d) $\frac{16}{7}$

CBSE-2023

Ans. (b) :

Section-B (Very Short Answer)

75. Describe LASER under the following points :
(a) Meaning :
(b) Basic Principle;
(c) Uses.

MP Board-2012

76. Give elementary idea of Raman effect.

J&K Board-2012

77. Name the series of lines in the hydrogen spectrum which lies in the ultraviolet region.

ISC-2013

78. Describe absorption spectrum of sodium.

ISC-2009

79. State the basic postulates of Bohr's theory of atomic spectra.

AP Board-2021

80. Name the series of the hydrogen spectrum whose lines fall in the visible region.

Rajasthan Board-2023

81. What are emission and absorption spectra?

Tamil Nadu Board-September, 2016

Section-C (Short Answer)

82. The ground state energy of hydrogen atom is –13.6 eV. If an electron makes a transition from an energy level –1.51 eV to –3.4 eV, then calculate the wavelength of the spectral line emitted and name the series of hydrogen spectrum to which it belongs.

CBSE Delhi-2016

83. What is a continuous emission spectrum ? Name one source of light which produces such a spectrum.
(ii) Explain in brief why dark lines are observed in the solar spectrum.

ISC-2010

84. Differentiate between line, band continuous spectra. What type of substances give rise to these spectra ?

ISC-2007

85. Discuss Bohr's atomic model.

UP Board-2019, 2023
Haryana Board-2018

Section-D (Long Answer)

86. (i) Name a series of lines of hydrogen spectrum which lies in
(a) visible region
(b) UV region
(ii) Write Bohr's formula to calculate wavelength (λ) of visible light emitted by hydrogen and explain the meaning of each and every symbol used.

ISC-2011

III. Model and Energy Level

Section-A (Multiple Choice Questions)

87. The ground state energy of H – atom is 13.6 eV. The energy needed to ionize H-atom from its second excited state-
(a) 3.4 eV (b) 1.51 eV
(c) 12.1 eV (d) 13.6 eV

Manipur Board-2022

Ans. (b) :

88. The energy required to remove an electron from the n = 2 state of hydrogen atom is
(a) 27.2 eV (b) 13.6 eV
(c) 6.8 eV (d) 3.4 eV

Meghalaya Board-2021

Ans. (d) :

89. The energy required to excite an electron of the hydrogen atom from its ground state to second excited state is _____ev.
(a) 13.6 (b) 12.09
(c) 10.2 (d) 3.40

Gujarat Board-March, 2022

Ans. (b) :

90. The energy of electron in the excited state of hydrogen atom is –0.85 eV. If 'h' is Planck's constant, the angular momentum of electron in the excited state is :
(a) $\frac{4h}{2\pi}$ (b) h
(c) $\frac{3h}{2\pi}$ (d) $\frac{h}{\pi}$

Tamil Nadu Board-2018

Ans. (a) :

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91. A hydrogen atom makes a transition from n = 5 to n = 1 orbit. The wavelength of photon emitted is λ. The wavelength of photon emitted when it makes a transition from n = 5 to n = 2 orbit is

(a) $\frac{8}{7}\lambda$ (b) $\frac{16}{7}\lambda$

(c) $\frac{24}{7}\lambda$ (d) $\frac{32}{7}\lambda$

CBSE-2023

Ans. (d) :

92. Hydrogen atom initially in the ground state, absorbs a photon which excites it to n = 5 level. The wavelength of the photon is :

(a) 975 nm (b) 740 nm

(c) 523 nm (d) 95 nm

CBSE-2023

Ans. (d) :

93. The radius of the nth orbit in Bohr model of hydrogen atom is proportional to :

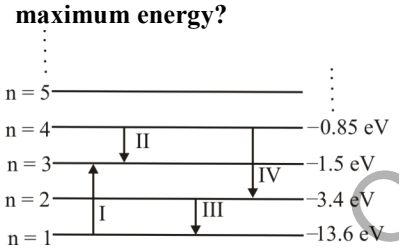
(a) $\frac{1}{n^2}$ (b) $\frac{1}{n}$

(c) n^2 (d) n

CBSE-2023

Ans. (c) :

94. The figure shows the energy level diagram of hydrogen atom with few transitions. Which transition shows the emission of photon with maximum energy?



(a) I (b) II

(c) III (d) IV

CBSE-2020

Ans. (c) :

95. The potential energy of an electron in the second excited state in hydrogen atom is :

(a) –3.4 eV (b) –3.02 eV

(c) –1.51 eV (d) –6.8 eV

CBSE-2023

Ans. (d) :

96. In Bohr's model of hydrogen atom, the total energy of the electron in n^{th} discrete orbit is proportional to

(a) n (b) $\frac{1}{n}$

(c) n^2 (d) $\frac{1}{n^2}$

CBSE-2020

Ans. (d) :

97. A hydrogen atom absorbs 12.1 eV of energy and gets excited to higher energy level. How many photons are emitted during downward transition. Assume during each downward transition, one photon is emitted.

(a) 2 or 3 (b) 1 or 3

(c) 1 or 2 (d) 5 or more

Gujarat Board- March, 2019

Ans. (b) :

98. The Bohr model of atoms

(a) assumes that the angular momentum of electrons is quantized

(b) uses Einstein's photoelectric equation

(c) predicts continuous emission spectra for atoms

(d) predicts the same emission spectra for all types of atoms

Jharkhand Board-2023

Ans. (a) :

99. If the radius of the first Bohr's orbit is r, the radius of second Bohr's orbit is.

(a) 2r (b) 4r

(c) r/2 (d) r/4

Jharkhand Board-2020

Ans. (b) :

100. The difference in angular momentum of electrons between two successive orbits of hydrogen atom is:

(a) $\frac{h}{\pi}$ (b) $\frac{h}{2}$

(c) $\frac{h}{2\pi}$ (d) 2h

UP Board-2022

Ans. (c) :

101. Total energy of an electron in the ground state of hydrogen atom is –13.6 eV. Its total energy when hydrogen atom is in the first excited state, is

(a) +13.6 eV (b) +3.4 eV

(c) –3.4 eV (d) –54.4 eV

ISC-2016

Ans. (c) :

102. The radius of the nth orbit in Bohr model of hydrogen atom is proportional to

(a) n^2 (b) $\frac{1}{n^2}$

(c) n (d) $\frac{1}{n}$

CBSE-2023

Ans. (a) :

103. The diagram shows four energy level of an electron in Bohr model of hydrogen atom. Identify the transition in which the emitted photon will have the highest energy.

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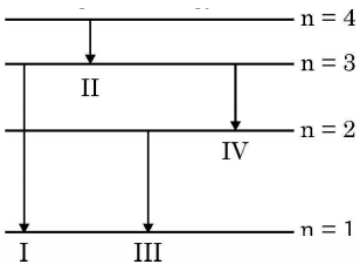

(a) I (b) II
(c) III (d) IV

CBSE-2023

Ans. (c) :

104. The electric potential of an electron is given by $V = V_0 \ln\left(\frac{r}{r_0}\right)$, where r_0 is a constant. If Bohr atom model is valid , then variation of radius of nth orbit r_n with the principal quantum number n is :

(a) $r_n \propto \frac{1}{n^2}$ (b) $r_n \propto \frac{1}{n}$
(c) $r_n \propto n^2$ (d) $r_n \propto n$

Tamil Nadu Board-2022

Ans. (c) :

105. The energy of election in the first orbit of hydrogen atom is –13.6 eV. Its potential energy is:

(a) 13.6 eV (b) 27.2 eV
(c) –27.2 eV (d) – 6.8 eV

Tamil Nadu Board-2017

Ans. (c) :

106. The ratio of the radii of the first three Bohr orbits of the hydrogen atom is

(a) $1:\frac{1}{2} : \frac{1}{3}$ (b) 1 : 2 : 3
(c) 1 : 4 : 9 (d) 1 : 8 : 27.

Tamil Nadu Board-2011

Ans. (c) :

107. According to Bohr's hypothesis, the angular momentum of the electron in any stationary orbit of radius r is proportional to

(a) $\sqrt{r}$ (b) $\frac{1}{r}$
(c) r (d) r^2

Gujarat Board- May, 2021

Ans. (a) :

108. The ground state energy of hydrogen atom is –13.6 eV. What are the kinetic and potential energy of the electron in this state?

(a) 13.6 eV, 27.2 eV (b) $-13.6\,eV, -27.2\,eV$
(c) 13.6 eV,–27.2 eV (d) 27.2 eV,–13.6 eV

Gujarat Board- August, 2020

Ans. (c) :

109. The first excitation potential energy or the minimum energy required to excite the atom from ground state of hydrogen atom is :

(a) 13.6 eV (b) 10.2 eV
(c) 3.4 eV (d) 1.89 eV

Tamil Nadu Board-2016

Ans. (b) :

110. What is the angular momentum of an electron of Li - atom in n = 5 orbit?

(a) 6.625×10^{-34} Js (b) 5.27×10^{-34} Js
(c) 1.325×10^{-34} Js (d) 16.56×10^{-34} Js

Gujarat Board- March, 2019

Ans. (b) :

111. If E_P and E_K represent potential energy and kinetic energy respectively of an orbital electron, then according to Bohr's theory

(a) $E_K = E_P/2$ (b) $E_K = E$
(c) $E_K = 2E$ (d) $E_K = 2E$

ISC-2015

Ans. (a) :

112. According to Bohr's postulates, which of the following quantities take discrete values?

(a) kinetic energy (b) Potential energy
(c) angular momentum (d) Momentum

Tamil Nadu Board-September, 2016

Ans. (c) :

113. The first excitation potential energy or the minimum energy required to excite the hydrogen atom from ground state :

(a) 13.6 eV (b) 10.2 eV
(c) 3.4 eV (d) 1.89 eV

Tamil Nadu Board-September, 2016

Ans. (b) :

114. 13.6 eV energy is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius of corresponding electron.

(a) 5.3×10^{-11} m (b) 10.6×10^{-11} m
(c) 2.65×10^{-11} m (d) 1.33×10^{-11} m

Gujarat Board- March, 2020

Ans. (a) :

115. If the potential energy of the electron in the hydrogen atom is $\frac{-e^2}{4\pi\varepsilon_0 r}$, then what is its kinetic energy?

(a) $\frac{e^2}{8\pi\varepsilon_0 r}$ (b) $\frac{-e^2}{4\pi\varepsilon_0 r}$
(c) $\frac{-e^2}{8\pi\varepsilon_0 r}$ (d) $\frac{e^2}{4\pi\varepsilon_0 r}$

Gujarat Board- March, 2019

Ans. (a) :

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116. What is the ratio of total energy of an electron in hydrogen atom in first excited state and third excited state?

(a) 4 : 1 (b) 3 : 1
(c) 1 : 1 (d) 1 : 4

Gujarat Board-2023

Ans. (a) :

117. If the radius of the first orbit of hydrogen atom is 5.3×10^{-11}m, then the radius of the second orbit is

(a) 1.12 Å (b) 2.12 Å
(c) 3.22 Å (d) 4.54 Å

Jharkhand Board-2019

Ans. (b) :

118. The angular momentum of an electron in the lowest energy state of hydrogen atom is

(a) $\frac{h}{2\pi}$ (b) $\frac{h}{\pi}$
(c) $\frac{3h}{2\pi}$ (d) $\frac{2h}{\pi}$

NIOS-2022

Ans. (a) :

119. The ground-state energy of the electron in hydrogen atom is

(a) 10 eV (b) –10 eV
(c) –13.6 eV (d) 5.8 eV

Odisha Board-2023

Ans. (c) :

120. The angular momentum of electron in the second stationary orbit of hydrogen atom is

(a) $\frac{h}{\pi}$ (b) $\frac{h}{2\pi}$
(c) $\frac{2h}{\pi}$ (d) $\frac{4h}{\pi}$

Odisha Board-2022

Ans. (a) :

121. If a is the first Bohr radius in hydrogen atom, then the radius of the third orbit is

(a) 3a (b) 6a
(c) 9a (d) 12a

Odisha Board-2022

Ans. (c) :

Section-B (Very Short Answer)

122. Calculate the de-Broglie wavelength of the electron orbiting in the n = 2 states of hydrogen atom.

CBSE All India-2016

123. What is the lonization energy of H - atom?

J&K Board-2021

124. The radius of innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. What is the radius of orbit in the second excited state?

CBSE Delhi-2010

125. Sketch the energy level diagram for hydrogen atom mark the transition corresponding to Lyman and Balmer series.

Nagaland Board-2020

126. The atomic hydrogen emits lines spectrum consisting of various series.
(a) Name the series observed first.
(b) Draw the energy level diagram of hydrogen atom.

Kerala Board-2016

127. A 12.09 eV electron beam is used to bombard gaseous hydrogen at room temperature. What series of wavelengths will be emitted?
[use hc = 1242 eV]

Gujarat Board- July, 2022

128. Find the wavelength of the radiation emitted by hydrogen atom when the electron jumps from n = 3 to n = 2 state.

Odisha Board-2023

129. The ground state energy of hydrogen atom is –13.6 eV. What are the kinetic and potential energies of electron in this state?

CBSE All India-2014, 2010

130. Write the mathematical form of Bohr's postulate regarding angular momentum of electron in atom.
(Write the answer only)

Odisha Board-2023

131. Define ionisation energy. What is its value for a hydrogen atom?

CBSE All India-2010

132. State Bohr's quantization condition for defining stationary orbits.

CBSE Foreign-2010

133. If radius of first electron orbit of hydrogen is a_0, radius of second electron orbit of hydrogen is _____.

Kerala Board-2021

134. What is meant by ionization energy ? Write its value for hydrogen atom?

CBSE-2023

135. An electron in hydrogen atom jumps from state n = 3 to n = 1. The change in the angular momentum of the electron will be _____.

CBSE-2020

136. State Bohr's quantization condition for defining stationary orbits.

CBSE-2022

137. In accordance with the Bohr's model, find the quantum number that characterises the earth's revolution around the Sun in an orbit of radius 1.5×10^{11} m with orbital speed 3×10^{4} ms^{-1} (Mass of the earth = 6×10^{24} kg)

Gujarat Board- March, 2020

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138. Find the :
(i) Angular momentum
(b) Velocity of the electron revolving in the 5th orbit of hydrogen atom.
($h = 6.6 \times 10^{-34}$ Js ; $m = 9.1 \times 10^{-31}$ kg)
Tamil Nadu Board-2022

139. What do you mean by Bohr's stable orbit ?
Bihar Board-2022

140. What are the limitations of Bohr's theory of hydrogen atom?
Bihar Board-2019, 2023
AP Board-2022

141. The ground state energy of hydrogen atom is –13.6 eV. What is the potential energy and kinetic energy of an electron in the third excited state ?
CBSE-2023

142. Using Bohr's postulates, obtain the expression for radius of nth stable orbit in a hydrogen atom.
CBSE-2023

144. A hydrogen atom in the ground state is excited by an electron beam of 12.5 eV energy. Find out the maximum number of lines emitted by the atom its excited state.
CBSE-2019

145. The energy on the first Bohr's orbit is –27.2 eV. What will be the energy in the third orbit ?
ISC-2005

146. For Bohr's model of the hydrogen atom, the energy of the electron in ground state is found to be –13.6 eV.
(i) Draw energy level diagram for the hydrogen atom and mark the values of energy (in eV at n = 2 and n = ∞).
(ii) Obtain the maximum energy of photon emitted by the hydrogen atom in eV.
ISC-2005

147. Find the angular momentum of an electron when it is the second Bohr's orbit of hydrogen atom.
ISC-2011

148. Calculate angular momentum of an electron in the third Bohr orbit of hydrogen atom.
ISC-2016

149. According to Bohr, 'angular momentum of an orbiting electron is quantised.' What is meant by this statement ?
ISC-2007

150. An electron in a hydrogen atom in the second excited state jumps to the first and ground state of the atom. Find the ratio of the wavelengths emitted during this process.
CBSE-2019

151. If a hydrogen atom goes from III excited state to II excited state, what kind of radiation is emitted ?
ISC-2009

152. Mention the postulates of Bohr's model of atom. What are the limitations of Bohr's model?
Uttarakhand Board-2020
Karnataka Board-March, 2019
Jharkhand Board-2018
Karnataka Board-July, 2015

153. State the postulates of Bohr's atomic model.
UP Board-2023
Chhattisgarh Board-2023
MP Board-2021
ISC-2007

154. According to Bohr's atomic model, the circumference of the electron orbit is always an ____ multiple of de Broglie wavelength.
CBSE-2020

155. Write Bohr's postulates for the hydrogen atom model.
Kerala Board-2021
Karnataka Board-July, 2018

156. The total energy of the electron in the ground state of Hydrogen atom is – 13.6 eV. Find the kinetic energy and potential energy of electron in this state.
Rajasthan Board-2023

157. Write the value of Bohr's radius.
Nagaland Board-2020

158. The total energy of hydrogen atom in a state is – 3·4 eV. What are the kinetic and potential energies of the electron in this state ?
CBSE-2022

159. Name the spectral series for a hydrogen atom which lies in the visible region. Find the ratio of the maximum to the minimum wavelengths of this series.
CBSE-2022

160. Derive an expression for potential and kinetic energy of an electron in any orbit of a hydrogen atom according to Bohr's atomic model.
Telangana Board-2015

Section-C (Short Answer)

161. Find out the wavelength of the electron orbiting in the ground state of hydrogen atom.
CBSE Delhi-2016

162. A hydrogen atom in the ground state is excited by an electron beam of 12.5 eV energy. Find out the maximum number of lines emitted by the atom from its excited state.
CBSE All India-2019

163. Using Bohr's total postulates, derive the expression for the total energy of the electron in the stationary states of hydrogen atom.
CBSE Foreign-2014

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164. The ground state energy of hydrogen atom is –13.6 eV. If an electron makes a transition from an energy level –0.85 eV to –1.51 eV, calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong?

CBSE All India-2012

165. Calculate the orbital period of the electron in the first excited state of hydrogen atom.

CBSE Delhi-2019

166. Obtain the expression for the ratio of the de-Broglie wavelengths associated with the electron orbiting in the second and third excited states of hydrogen atom.

CBSE Delhi-2019

167. State Bohr postulate of hydrogen atom that gives the relationship for the frequency of emitted photon in a transition.

CBSE Foreign-2016

168. Use de-Broglie's hypothesis to write the relation for the nth radius of Bohr orbit in terms of Bohr's quantization condition of orbital angular momentum.

Meghalaya Board-2015
CBSE Foreign-2016

169. Derive an expression for the total energy of an electron according to Bohr's theory to hydrogen atom.

Nagaland Board-2021

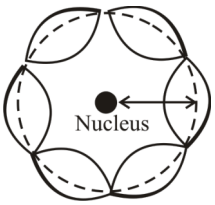
170. Using postulates of Bohr's theory of hydrogen atom, show that
(i) radii of orbits increases as n^2 and
(ii) the total energy of electron increases as $\frac{1}{n^2}$, where n is the principal quantum number of the atom.

CBSE All India-2011

171. Using the relevant Bohr's postulates, derive the expressions for the
(i) Speed of the electron in the nth orbit.
(ii) Radius of the nth orbit of the electron in hydrogen atom.

CBSE Delhi-2010

172. The electron in a hydrogen atom passes form n = 4 energy level to n = 1 energy level. What is the maximum number of photons that can be emitted ?
(b) The figure shows the standing particle wave on a circular orbit of an electron in a hydrogen atom.



(a) To which principal quantum number does the given orbit correspond to ?
(b) What is the angular momentum of the electron in this orbit?

Goa Board-2018

173. By assuming Bohr's postulates derive an expression for radius of nth orbit of electron, revolving round the nucleus of hydrogen atom.

Karnataka Board-March, 2015

174. What is the ratio of radii of the orbits corresponding to first excited state and ground state, in a hydrogen atom?

CBSE Delhi-2010

175. In the ground state of hydrogen atom, its Bohr radius is given as 5.3×10^{-11} m. The atom is excited such that the radius becomes 21.2×10^{-11} m. Find (i) the value of the principal quantum number and (ii) the total energy of the atom in this excited state.

CBSE Delhi-2013

176. Show that the radius of the orbit in hydrogen atom varies as n^2, where n is the principal quantum number of the atom.

CBSE All India-2015

177. Prove that the radius of the nth Bohr orbit of an atom is directly porportional to n^2, where n is the principal quantum number.

Meghalaya Board-2023, 2017

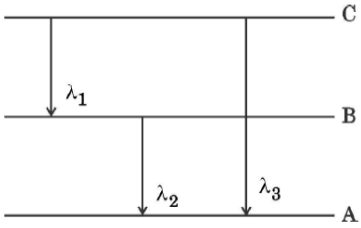
178. The energy of a hydrogen atom in the first excited state is – 3·4 eV. Find :
(a) the radius of this orbit. (Take Bohr radius = 0·53 Å)
(b) the angular momentum of the electron in the orbit.
(c) the kinetic and potential energy of the electron in the orbit.

CBSE-2022

179. An electron is in the third excited state in a hydrogen atom. It undergoes transitions to the lower energy states.
(a) What is the maximum number of spectral lines that can be emitted ?
(b) Calculate the minimum wavelength of the spectral lines emitted.

CBSE-2022

180. Use the energy level diagram shown below to obtain the relation between three wavelengths λ_1, λ_2 and λ_3 emitted due to the transition of electron from the energy states C and B.



CBSE-2022

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181. How did de Broglie hypothesis provide an explanation for Bohr's second postulate for quantisation of orbital angular momentum of the orbiting electron in hydrogen atom ? Discuss.

CBSE-2022

182. An electron revolves around the nucleus of hydrogen atom in a circular orbit of radius 5×10^{-11}m. Calculate

(i) intensity of electric field of the nucleus of the position of the electron.

(ii) electrostatic potential energy of the hydrogen nucleus and electron system.

ISC-2010

183. Using Bohr's model of hydrogen atom, derive mathematically that the energy of the electron in its nth orbit is given by $E_n = -\frac{13.6}{n^2}$eV.

NIOS-2017

184. The energy of an electron of excited hydrogen atom is –3.4 eV. Determine the angular momentum of the electron

UP Board-2023

185. Derive the expression for the radius of the ground states orbit of hydrogen using Bohr's postulates.

J&K Board-2014

186. Obtain an expression for the total energy of an electron in n^{th} Bohr orbit.

Nagaland Board-2017

187. Write the expression or Bohr's radius in hydrogen atom.

CBSE Delhi-2010

188. An electron is orbiting in 5th Bohr orbit. Calculate ionization energy for this atom, if the ground state energy is –13.6 eV.

Maharashtra Board-2015

189. Energy of an electron in the second Bohr orbit is –3.4 eV. Calculate the energy of an electron of an electron in the third Bohr orbit.

Maharashtra Board-2020

190. Energy of electron in the nth orbit of hydrogen atom is $E_n = -\frac{13.6}{n^2}$eV. What is the energy required to make electron free from first orbit of hydrogen atom ?

Kerala Board-2021

191. (i) Derive an expression for the orbital energy of an electron in hydrogen atom using Bohr theory.

(ii) An electron in Bohr's hydrogen atom has energy of –3.4 eV. What is the angular momentum of the electron?

Tamil Nadu Board-2023

192. (a) Use Bohr's Postulate to prove that the radius of nth orbit in a hydrogen atom is proportional to n^2.

(b) How will the energy of a hydrogen atom change if n increases from 1 to ∞ ?

CBSE-2022

193. Derive an expression for the radius of the first orbit of the electron of the hydrogen atom.

Assam Board-2015

194. Obtain Bohr's quantisation condition on the basis of the wave nature of an electron.

Assam Board-2015

195. Find the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its

(i) second permitted energy level to the first permitted level and

(ii) the highest permitted energy level to the first permitted level.

CBSE All India-2010

196. Obtain the first Bohr's radius and the ground state energy of a muonic hydrogen atom i.e. an atom where the electron is replaced by a negatively charged muon (μ^-) of mass about 207 m_e that orbits around a proton. (Given for hydrogen atom, radius of first orbit and ground state energy are 0.53×10^{-10} m and –13.6 eV respectively)

CBSE-2019

197. Energy levels of H-atom are given are

$$E_n = \frac{-13.6}{n^2}\text{eV}.$$

where, n = principal quantum number to calculate the wavelength of electromagnetic radiation emitted by hydrogen atom resulting from the transition n = 2 to n = 1.

ISC-2012

198. On the basis of Bohr's theory derive an expression for the radius of the nth orbit of an electron of hydrogen atom.

ISC-2014

199. State the postulate of Bohr's regarding

(i) angular momentum of electron.

(ii) emission of photon.

(iii) total energy of an electron orbiting around the nucleus of an atom is always negative. What is the significance of this ?

ISC-2013

200. From Bohr's energy quantisation formula, determine the target wavelength in the Balmer series of hydrogen atom spectrum.

ISC-2006

201. In a hydrogen atom, a transition of electron takes place from 3rd orbit to 2nd orbit. Calculate the wavelength of the emitted photon. To which spectral series will this photon belong ?

ISC-2005

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202. Write the expression for energy of an electron in electron orbit of hydrogen atom.

Karnataka Board-March, 2019

203. Using Bohr's atomic model, derive the expression for the velocity of electron revolving in the nth orbit of hydrogen atom.

CBSE-2020

204. (a) Sketch the energy level diagram for hydrogen atom.

(b) Find the ratio of the longest and the shortest wavelength in Lyman series in hydrogen atom.

CBSE-2022

205. Use Bohr's model of hydrogen atom to obtain the relationship between the angular momentum and the magnetic moment of the revolving electron.

CBSE-2020

206. (i) State three postulates of Bohr's theory of hydrogen atom.

(ii) Find the angular momentum of an electron revolving in the second orbit in Bohr's hydrogen atom.

CBSE-2023

207. State Bohr's quantization condition of angular momentum. Calculate the shortest wavelength of the Bracket series and state to which part of the electromagnetic spectrum does it belong.

OR

Calculate the orbital period of the electron in the first excited state of hydrogen atom.

CBSE-2019

208. Obtain Bohr's quantisation condition for angular momentum of electron orbiting in n^{th} orbit in hydrogen atom on the basis of the wave picture of an electron using de Broglie hypothesis.

CBSE-2019

209. A photon emitted during the de-excitation of electron from a state n to the first excited state in a hydrogen atom, irradiates a metallic cathode of work function 2 eV, in a photo cell, with a stopping potential of 0.55 V. Obtain the value of the quantum number of the state n.

CBSE-2019

210. Use Bohr's postulates to derive the expression for the potential and kinetic energy of the electron moving in the nth orbit of the hydrogen atom. How is the total energy of the electron expressed in terms of its kinetic and potential energies?

CBSE-2019

211. Deduce the expression for the total energy of the electron in the nth orbit of a hydrogen atom in the Bohr model. Assam Board-2016

212. Derive the expression for the radius of electron in the nth Bohr orbit of bydrogen electron atom.

Maharastra Board-2022

Karnataka Board-July, 2020

CBSE Delhi-2010

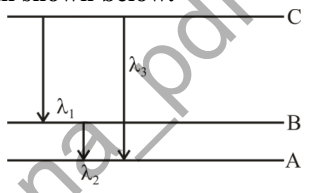
Section-D (Long Answer)

213. Derive an expression for the energy of an electron in n^{th} stationary orbit of hydrogen atom by assuming the expression for radius.

Karnataka Board-July, 2014, 2016, 2019

214. (i) State Bohr's quantization condition for defining stationary orbits. How does de-Broglie's hypothesis explain the stationary orbits?

(ii) Find the relation between the three wavelengths λ_1, λ_2 and λ_3 from the energy level diagram shown below.



CBSE All India-2014

215. (i) The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. Calculate its radius in n = 3 orbit.

(ii) The total energy of an electron in the first excited state of the hydrogen atom is –3.4 eV. Find out its (a) kinetic energy and (b) potential energy in this state.

CBSE Delhi-2014

216. Using Bohr's postulates for hydrogen atom, show that the total energy (E) of the electron in the stationary states can be expressed as the sum of kinetic energy (K) and potential energy (U), where K = –2U. Hence, deduce the expression for the total energy in the nth energy of hydrogen atom.

CBSE Foreign-2012

217. The value of ground state energy of hydrogen atom is –13.6 eV.

(i) Find the energy required to move an electron from the ground state to the first excited state of the atom.

(ii) Determine (A) the kinetic energy and (b) orbital radius in the first excited state of the atom.

(Given, the value of Bohr's radius = 0.53Å)

CBSE All India-2014

218. (i) State Bohr's postulate to define stable orbits in hydrogen atom. How does de-Broglie's hypothesis explain the stability of these orbits?

(ii) A hydrogen atom initially in the ground state absorbs a photon which excites it to the n = 4 level. Estimate the frequency of the photon.

CBSE All India-2018

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219. Calculate the ratio of the frequencies of the radiation emitted due to transition of the electron in a hydrogen atom from its

(i) Second permitted energy level to the first level

(ii) Highest permitted energy level to the second permitted level.

CBSE All India-2018

220. State Bohr's postulates for hydrogen atom. Derive an expression for the energy of the electron in its nth stationary orbit.

Odisha Board-2022

221. (i) Using Bohr's second postulate of quantization of orbital angular momentum show that the circumference of the electron in the nth orbital state in hydrogen atom is n-times the de-Broglie wavelength associated with it.

(ii) The electron in hydrogen atom is initially in the third excited state. What is the maximum number of spectral lines which can be emitted when it finally moves to the ground state?

CBSE Delhi-2012

222. A hydrogen atom is in its third excited state.

(a) How many spectral lines can be emitted by it before coming to the ground state? Show these transitions in the energy level diagram.

(b) In which of the above transitions will the spectral line of shortest wavelength be emitted?

CBSE-2020

223. (a) How did de-Broglie hypothesis provide an explanation for Bohr's second postulate for quantisation of orbital angular momentum of the orbiting electron in hydrogen atom ? Discuss.

(b) Identify the transition of electron in Bohr model which gives rise to

(i) the maximum, and (ii) the minimum wavelength in Balmer series of hydrogen spectrum.

CBSE-2022

224. State the postulates of Bohr's model of hydrogen atom and derive the expression for Bohr radius.

CBSE-2020

225. Mention the postulates of Bohr's atomic model and find the expression for the energy of electrons in stationary orbits of hydrogen atom

UP Board-2021

226. The ionisation potential of hydrogen atom is 13.6 eV. Draw the energy level diagram showing four levels. Calculate

(i) the energy of the photon emitted when an electron falls from the third orbit to the second orbit.

(ii) The wavelength of this photon.

ISC-2000

227. State Bohr's postulates for atomic model. Derive the equations for orbital radius, orbital speed and total energy for an electron in n^{th} orbit in hydrogen atom.

Gujarat Board-2023

ISC-2002

228. (a) Draw the graph of radius of orbit (r_n) in hydrogen atom as a function of orbit number (n).

(b) In a hydrogen atom, find the ratio of the time taken by the electron to complete one revolution in the first excited and in the second excited states.

CBSE-2020

229. Prove that the magnetic moment of the electron-revolving around a nucleus is an orbit of radius r with orbital speed v is equal to evr/2. Hence using Bohr's postulate of quantization of angular momentum, deduce the expression for the magnetic moment of hydrogen atom in the ground state.

CBSE-2019

230. Hydrogen atom in third excited state de-excites to the first excited state. Obtain the expressions for the frequency of radiation emitted in this process.

Also determine the ratio of the wavelengths of the emitted radiations when the atom de-excites from the third excited state to the second excited state and from the third excited state to the first excited state.

CBSE-2019

231. Obtain an expression for the kinetic energy of the electrons in the Bohr's model of hydrogen atom (Z = 1). Start from equating the electrostatic force with the centripetal force required and then use the quantisation condition for angular momentum.

ISC-2003

232. Give the expression for the velocity of electron in the first orbit of hydrogen atom for the radius in the ground state of hydrogen atom.

Hence, derive the expression for the magnetic field (B) at the centre of the nucleus due to the circular motion of electron.

ISC-2003

233. Explain the Raman scattering of light with the help of energy level diagram.

Tamil Nadu Board-2016

234. State Bohr's postulate to explain stable orbits in a hydrogen atom. Prove that the speed with which the electron revolves in n^{th} orbit is proportional to (1/n).

CBSE-2022

235. (a) The energy of hydrogen atom in an orbit is –1.51 eV. What are kinetic and potential energies of the electron in this orbit ?

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(b) The electron in a hydrogen atom is typically found at a distance of about 5.3×10^{-11} m from the nucleus which has a diameter of about 1.0×10^{-15} m. Assuming the hydrogen atom to be a sphere of radius 5.3×10^{-11} m, what fraction of its volume is occupied by the nucleus ?

CBSE-2022

236. State the postulates of Bohr atom model. Obtain the expression for the radius of the nth orbit of an electron based on Bohr's theory.

Tamil Nadu Board-2018

IV. Line Spectra of Hydrogen Atom

Section-A (Multiple Choice Questions)

237. Specify the transition of electron in the wavelength of the line in the Bohr model of hydrogen atom which gives rise to the spectral line of highest wavelength.

(a) n = 3 to n = 1 (b) n = 3 to n = 2
(c) n = 4 to n = 1 (d) n = 4 to n = 2

CBSE-2023

Ans. (b) :

238. Balmer series of spectral lines is obtained when an electron in hydrogen atom jumps from higher orbits to the :

(a) first orbit (b) second orbit
(c) third orbit (d) fourth orbit

NIOS-2019

Ans. (b) :

239. Which spectral series of hydrogen spectrum lies in the visible region of electromagnetic spectrum?

(a) Balmer (b) Lyman
(c) Paschen (d) Brackett

NIOS-2021
Jharkhand Board-2019

Ans. (a) :

240. The wavelength of H_α line for Balmer series is _____nm.

(a) 364.6 (b) 410.2
(c) 656.3 (d) 448.1

Gujarat Board- July, 2022

Ans. (c) :

241. What is the shortest wavelength present in the Paschen series of spectral lines?

(a) 820 nm (b) 6563 Å
(c) 911 nm (d) 656mm

Gujarat Board- March, 2020

Ans. (a) :

242. In hydrogen atom, which of the following transitions produces spectral line of maximum wavelength?

(a) $2 \rightarrow 1$ (b) $4 \rightarrow 1$
(c) $6 \rightarrow 5$ (d) $5 \rightarrow 2$

Tamil Nadu Board-September, 2017, 2016

Ans. (c) :

243. Which spectral series of hydrogen atom lie in the ultraviolet region?

(a) Lyman (b) Paschen
(a) Pfund (b) Balmer

Haryana Board-2018

Ans. (a) :

244. Which spectral series does not lie in the spectrum of hydrogen atom?

(a) Special (b) Lyman
(c) Balmar (d) Paschen

Haryana Board-2018

Ans. (a) :

245. Which spectral series of hydrogen atom lie in the infrared region?

(a) Lyman (b) Paschen
(c) Balmer (d) None of these

Haryana Board-2018

Ans. (b) :

246. Which of the following series of H-atom lies in visible range?

(a) Paschen (b) Balmer
(c) Lymen (d) Pfund

Haryana Board-2016

Ans. (b) :

247. Which one of the following spectral line lies in Ultraviolet region?

(a) Paschen series (b) Balmer series
(c) Lyman series (d) Pfund sereis

Gujarat Board-March, 2022

Ans. (c) :

248. The transition of electron from n = 4, 5, 6,…. to n = 3 corresponds to

(a) Lyman series (b) Balmer series
(c) Paschen series (d) Brackett series

Meghalaya Board-2023

Ans. (c) :

249 The radius of eighth orbit of electron in H-atom will be more than that of fourth orbit by a factor of _____.

(a) 2 (b) 4
(c) 8 (d) 16

Maharashtra Board-2023

Ans. (b) :

Section-B (Very Short Answer)

250. The longest wavelength in Balmer series produced by atomic hydrogen is 656.4 nm. Find the shortest wavelength in this series.

Kerala Board-2017

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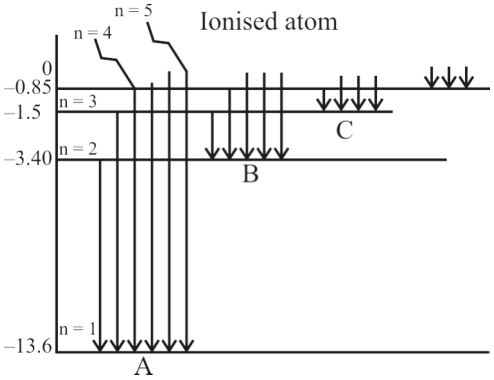
251. The atomic line spectra of hydrogen atom is shown in figure.



Write the names of the series A, B and C.

Kerala Board-2020

252. Name the spectral series of hydrogen atom which lies in the visible region of electromagnetic spectrum.

Odisha Board-2023
Karnataka Board-July, 2019
Karnataka Board-2011

253. The electron in the hydrogen atom is moving with a speed of 2.3×10^6 m/s in an orbit of radius 0.53A. Calculate the period of revolution of electron. ($\pi = 3.142$)

Maharashtra Board-2018

254. In hydrogen spectrum the shortest wavelength in Balmer Series is λ. What will be the shortest wavelength in Brackett Series?

Assam Board-2016

255. Wavelength of 1st line (H_α) of Balmer series of hydrogen is 656.3 nm. Find the wavelength of its 2nd line (H_β).

ISC-2009

256. Calculate the wavelength of the second line of Lyman series in a spectrum of hydrogen atom. (Take Rydberg constant, $R = 1.1 \times 10^7\ m^{-1}$)

CBSE-2023

257. Wavelengths of the first lines of the Lyman series, Paschen series and Balmer series, in hydrogen spectrum are denoted by λ_L, λ_P and λ_B respectively. Arrange these wavelengths in increasing order.

ISC-2015

258. Calculate the maximum and minimum wavelength for the Balmer series of hydrogen atom ($R = 1.097 \times 10^7 m^{-1}$)

Chhattisgarh Board-2021

259. The Rydberg constant for Hydrogen is $1.097 \times 10^7\ m^{-1}$. Calculate the short wavelength limit of Lyman series.

Tamil Nadu Board-2017

260. Identify the transition of electron in Bohr model which gives rise to
(i) the maximum, and
(ii) the minimum wavelength in Balmer series of hydrogen spectrum.

CBSE-2022

261. What do you mean by Balmer series ?

Bihar Board-2021

262. State the name of the visible series in hydrogen spectrum.

Maharashtra Board-2020

263. A hydrogen atom in its excited state emits radiations of wavelengths 1218 Å and 974·3 Å when it finally comes to the ground state. Identify the energy levels from where transitions occur. Given Rydberg constant $R = 1{\cdot}1 \times 10^7\ m^{-1}$. Also specify the spectral series to which these lines belong.

CBSE-2019

264. Find de Broglic wavelength of electron in the fourth orbit of hydrogen atom.

Tamil Nadu Board-2011

265. Calculate the shortest wavelength in the Balmer series o hydrogen atom. In which region (infrared, visible, ultraviolet) of hydrogen spectrum does this wavelength lie?

CBSE Delhi-2015

266. When is H_α-line of the Balmer series in the emission spectrum of hydrogen atom obtained?

CBSE Delhi-2013

Section-C (Short Answer)

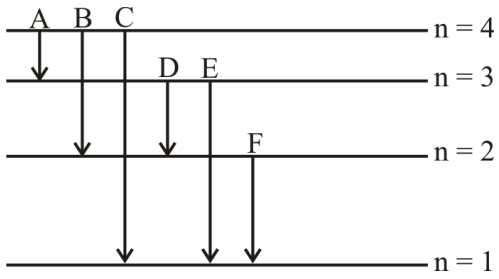
267. Calculate the shortest and longest wavelengths of Balmer series of hydrogen atom.
Given $R = 1.097 \times 10^7 m^{-1}$

Karnataka Board-March, 2016

268. The first member of Balmer series of hydrogen atom has wavelength of 6563 $\overset{0}{A}$. Calculate the wavelength and frequency of the second member of the same series.
Given: $C = 3 \times 10^8\ ms^{-1}$.

Karnataka Board-March, 2017

269. The figure shows energy level diagram of hydrogen atom.



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(i) Find out the transition which results in the emission of a photon of wavelength 496 nm.

(ii) Which transition corresponds to the emission of radiation of maximum wavelength? Justify your answer.

CBSE All India-2015

270. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. Upto which energy level the hydrogen atoms would be excited?

Calculate the wavelengths of the first member of Lyman and first member of Balmer series.

CBSE Delhi-2014

271. Using Rydberg's formula, calculate the wavelength of spectral lines of the first members of the Lyman series and of the Balmer series.

CBSE Foreign-2014

272. The electron in a given Bohr orbit has a total energy of –1.5 eV. Calculate its

(i) kinetic energy

(ii) potential energy

(iii) wavelength of radiation emitted, when this electron makes a transition to the ground state.

[Given, energy in the ground state = –13.6 eV and Rydberg's constant = 1.09×10^7 m^{-1}]

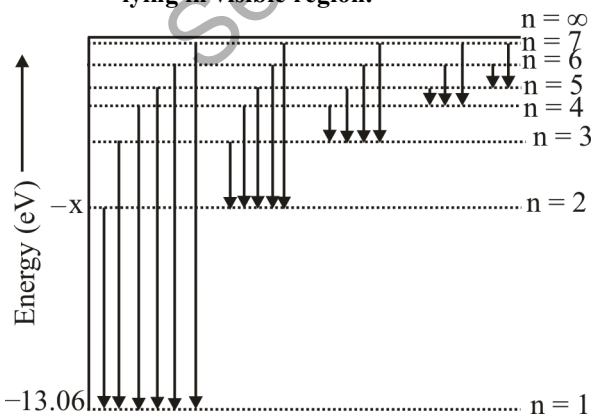
CBSE Delhi-2011

273. Figure shows the energy levels of hydrogen atom.

(i) Name the series of hydrogen spectrum which has the radiation of least wavelength.

(ii) Write the value of X in eV for the electron in n = 2 orbit.

(c) Name the series of hydrogen spectrum lying in visible region.



Goa Board-2019

274. Drawing a neat energy level diagram, show the various spectral series of hydrogen atom and also write the formula for frequency of these spectral lines.

Uttarakhand Board-2020

275. The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 Å. Calculate the short wavelength limit for Balmer series of the hydrogen spectrum.

CBSE Delhi-2016

276. A 12.5 eV electron beam is used to excite a gaseous hydrogen atom at room temperature. Determine the wavelengths and the corresponding series of the lines emitted.

CBSE All India-2016

277. Draw a neat and labelled energy level diagram and explain Balmer series and Brackett series of spectral lines for hydrogen atom.

Maharashtra Board-2018

278. Draw the energy-level diagram of hydrogen atom. Show the Lyman series and Pfund series in the diagram.

Meghalaya Board-2013, 2018

279. When a vapour is excited at low pressure by passing an electric current through it, a spectrum is obtained.

(a) Draw a spectral series of emission lines in hydrogen

(b) Name the different series of hydrogen atom.

(c) In which region Lyman series is located

Kerala Board-2014

280. Explain the four spectral series of hydrogen atom.

Tamil Nadu Board-2016, 2022

Nagaland Board-2017, 2021

281. (i) Using postulates of Bohr's theory of hydrogen atom, show that

(A) The radii of orbits increase as n^2

(B) The total energy of the electron increases as $1/n^2$, where n is the principal quantum number of the atom.

(ii) Calculate the wavelength of H_α-line in Balmer series of hydrogen atom.

Given, Rydberg constat,

$R = 1.097 \times 10^7$ m^{-1}.

CBSE All India-2011

282. Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number n_i) to the lower state, (n_f). When electron in hydrogen atom jumps from energy state $n_i = 4$ to $n_f = 3, 2, 1$. Identify the spectral series to which the emission lines belong.

CBSE All India-2013

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283. Find the ratio of the longest and the shortest wavelengths amongst the spectral lines of Balmer series in the spectrum of hydrogen atom.

CBSE-2020

284. Using the Rydberg formula. Calculate the wavelengths of the first four spectral lines in the Lyman series of the hydrogen spectrum.

Gujarat Board- August, 2020

285. State Bohr's quantization condition of angular momentum. Calculate the shortest wavelength of the Brackett series and state to which part of the electromagnetic spectrum does it belong.

CBSE Delhi-2019

286. The wavelength of the second line of the Balmer series in the hydrogen spectrum is 4861 Å. Calculate the wavelength of the first line of the same series.

CBSE-2023

287. Using the Rydberg formula for the spectrum of hydrogen atom, calculate the largest and shortest wavelengths of the emission lines of the Balmer series in the spectrum of hydrogen atom. (Use the value of Rydberg constant R = 1.1×10^7 m^{-1})

CBSE-2019

288. (i) How are various lines of Lyman series formed ? Explain on the basis of Bohr's theory.
(ii) Calculate the shortest wavelength of electromagnetic radiation present in Balmer series of hydrogen spectrum.

ISC-2015

289. The H_α - line in Balmer series of the hydrogen spectrum has a wavelength 6563Å. From this calculate the wavelength for the first line of the Lyman series (Ly_α).

Gujarat Board-May, 2021

290. Prove that the ratio of minimum wave lengths for the Lyman, Balmer and Paschen series of hydrogen atom is 1 : 4 : 9.

Chhattisgarh Board-2023

291. In the Lyman series of hydrogen atom
(i) Write the formula to find wavelength
(ii) What is the range of maximum and minimum wavelength?
(iii) in which region of the spectrum does this range fall?

Chhattisgarh Board-2019, 2022

292. Calculate the longest and shortest wavelength in the Lyman series of hydrogen emission spectrum. (Rydberg constant R=$1.1\times10^7 m^{-1}$). 2

Uttarakhand Board-2019

293. The wavelength of first member of Balmer Series is 6563 A. Calculate wavelength of second member of Lyman Series.

AP Board-2020

294. Draw the energy-level diagram hydrogen atom and show the transitior of electrons corresponding to Blame series.

Odisha Board-2022

295. (a) Sketch the energy level diagram for hydrogen atom.
(b) Find the ratio the longest and the shorts wavelength in Lyman series in hydrogen atom.

CBSE-2020

296. An electron in a hydrogen atom makes transitions from orbits of higher energies to orbits of lower energies.
(i) When will such transitions result in (a) Lyman (b) Blamer series ?
(ii) Find the ratio of the longest wavelength in Lyman series to the shortest wavelength in Balmer series.

CBSE-2022

297. In hydrogen atom an electron is in 3rd excited state. Finally it returns to ground state. Depict all the possible spectral lines likely to be emitted. Also mention their numbers too.

UP Board-2021

298. Draw energy level diagram for hydrogen atom, showing first four energy levels corresponding to n = 1, 2, 3 and 4. Show transitions responsible for
(i) Absorption spectrum of Lyman series.
(ii) Emission spectrum of Balmer series.

ISC-2016

299. The ground state energy of hydrogen atom is 13·6 eV in Bohr model. An electron makes a transition from an energy level of –1·51 eV to that of –3·4 eV. Calculate the wavelength of the spectral line emitted.

CBSE-2023

300. Name the series of hydrogen spectrum lying in ultraviolet and visible region.

Manipur Board-2022
Meghalaya Board-2019

301. Determine the shortest wavelengths of Balmer and Paschen series. Given the limit for Lyman series is 912 Å.

Maharashtra Board-2022

302. Using an expression for energy of electron, obtain the Bohr's formula for hydrogen spectral lines.

Maharashtra Board-2019

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303. Define ionisation energy. How would the ionisation energy change when electron in hydrogen atom is replaced by a particle of mass 200 times that of the electron but having the same charge?

CBSE All India-2013

304. Calculate the shortest wavelength of the spectral lines emitted in Balmer series.
[Given, Rydberg constant, $R = 10^7\ m^{-1}$]

CBSE All India-2015

305. Find the ratio between the wavelengths of the 'most energetic' spectral lines in the Balmer and Paschen series of the hydrogen spectrum.

CBSE All India-2016

306. An electron jumps from fourth to first orbit in an atom. How many maximum number of spectral lines can be emitted by the atom?
To which series these lines correspond?

CBSE Foreign-2016

Section-D (Long Answer)

307. Using the Bohr's postulates, obtain the expression for the total energy of the electron in the stationary states of the hydrogen atom. Hence, draw the energy level diagram showing how the line spectra corresponding to Balmer series occur due to transition between energy levels.

CBSE Delhi-2013

308. Using the postulates of Bohr's model of hydrogen atom, obtain an expression for the frequency of radiation emitted when the atom makes a transition from the higher energy state with quantum number n_i to the lower energy state with quantum number $n_f (n_f < n_i)$.

CBSE Foreign-2011

309. State any two postulates of Bohr's theory of hydrogen atom. What is the maximum possible number of spectral lines observed when the hydrogen atom is in its second excited state? Justify your answer. Calculate the ratio of the maximum and minimum wavelengths of the radiations emitted in this process.

CBSE All India-2010

310. Draw the energy level diagram for hydrogen atom. Show the transitions of Lyman, Balmer, Paschen, Brackett and Pfund series in the diagram. In which region do these spectrum lie?

UP Board-2023

311. Draw a level diagram of hydrogen, shown by a downward or an upward arrow, a transition which results in.
(i) emission line of Balmer series
(ii) emission of Lyman series
(iii) absorption line of Lyman series.

ISC-2010

312. Draw an energy level diagram for hydrogen atom. Explain the origin of Lyman, Balmer and Paschen series in hydrogen spectrum. Which of these lies in the visible region of the spectrum ?

UP Board-2017

314. (a) How is the stability of hydrogen atom in Bohr model explained by de-Broglie's hypothesis?
(b) A hydrogen atom initially in the ground state absorbs a photon which excites it to n = 4 level. When it gets de-excited, find the maximum number of lines which are emitted by the atom. Identify the series to which these lines belong. which of them has the shortest wavelength?

CBSE-2019

315. (a) Using Bohr's postulates, derive the expression for the orbital period of the electron moving in the nth orbit of hydrogen atom.
(b) Write Rydberg's formula for wavelengthsof the spectral lines of hydrogen atom spectrum. Mention to which series in the emission spectrum of hydrogen, H_α line belongs.

CBSE-2019

316. Explain atomic spectra. Write the equation for Lyman series, Paschen series, Brackett series & Pfund series for hydrogen atom.

Gujarat Board-2023

317. (i) Draw the energy level diagram for the line spectra representing Lyman series and Balmer series in the spectrum of hydrogen atom.
(ii) Using the Rydberg formula for the spectrum of hydrogen atom, calculate the largest and shortest wavelengths of the emission lines of the Balmer series in the spectrum of hydrogen atom.
(Use the value o Rydberg constant, $R = 1.1 \times 10^7\ m^{-1}$)

CBSE All India-2019

318. In hydrogen atom, an electron undergoes transition from second excited state to the first excited state and then to the ground state. Identify the spectral series to which these transitions belong.
(ii) Find out the ratio o the wavelengths of the emitted radiations in the two cases.

CBSE Delhi-2012

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13. Nuclei

I. Composition of Nucleus, and Atomic masses, Size of Nucleus

Section-A (Multiple Choice Questions)

24. What is the value of speed of γ-rays in vacuum?
(a) 2c (b) c
(c) $\frac{c}{2}$ (d) $\frac{c}{\sqrt{2}}$
Haryana Board-2018

Ans. (b) :

1. In the nuclear reaction $_{80}Hg^{198} + X \rightarrow {}_{79}Au^{198} + {}_{1}H^{1}$, X stands for:
(a) proton (b) electron
(c) neutron (d) deutron
Tamil Nadu Board-September, 2016

Ans. (c) :

2. The nuclear radius of $_4Be^8$ nucleus is:
(a) 1.3×10^{-15}m (b) 2.6×10^{-15}m
(c) 1.3×10^{-13}m (d) 2.6×10^{-13}m
Tamil Nadu Board-March, 2016

Ans. (b) :

3. In a Bainbridge mass spectrometer positive rays of the same element produce different traces. The traces correspond to :
(a) isotopes (b) isobars
(c) isotones (d) none of the above
Tamil Nadu Board-2017

Ans. (a) :

4. The nucleus is approximately spherical in shape. Then the surface area of nucleus having mass number A varies as:
(a) $A^{5/3}$ (b) $A^{2/3}$
(c) $A^{4/3}$ (d) $A^{1/3}$
Tamil Nadu Board-2023

Ans. (b) :

5. Number and type of nucleons in the nucleus of Helium $\left({}_2He^4\right)$ will be:
(a) 2 protons
(b) 2 protons and 2 neutrons
(c) 2 protons and 2 electrons
(d) 2 neutrons
Haryana Board-2022

Ans. (b) :

6. In $_{88}Ra^{226}$ nucleus, there are
(a) 138 protons and 88 neutrons
(b) 138 neutrons and 88 protons
(c) 226 protons and 88 electrons
(d) 226 neutrons and 138 electrons
Jharkhand Board-2023, 2018

Ans. (b) :

7. The nuclear radius is of the order of
(a) 10^{-10}m (b) 10^{-12}m
(c) 10^{-15}m (d) 10^{-19}m
Jharkhand Board-2020

Ans. (c) :

8. The energy equivalent of 1 gram of substance is :
(a) 9×10^6 Joule (b) 3×10^{13} Joule
(c) 3×10^6 Joule (d) 9×10^{13} Joule
MP Board-2020, 2019

Ans. (d) :

9. The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is
(a) $\frac{64}{125}$ (b) $\frac{4}{5}$
(c) $\frac{5}{4}$ (d) 1
CBSE-2023

Ans. (d) :

10. The radius of $^{27}_{13}X$ nucleus is R. The radius of $^{125}_{53}Y$ nucleus will be
(a) $\frac{5}{3}R$ (b) $\left(\frac{13}{53}\right)^{1/3}R$
(c) $\left(\frac{5}{3}R\right)^{1/3}$ (d) $\left(\frac{13}{53}R\right)^{1/3}$
CBSE-2023

Ans. (a) :

11. The nuclear force between two protons, two neutrons and between a proton and a neutron is denoted by f_{pp}, f_{nn} and f_{pn} respectively, then
(a) $f_{pp} = f_{nn} \neq f_{pn}$ (b) $f_{pp} \neq f_{nn} = f_{pn}$
(c) $f_{pp} = f_{nn} = f_{pn}$ (d) $f_{pp} \neq f_{nn} \neq f_{pn}$
Kerala Board-2016

Ans. (c) :

12. The density of nucleus is of the order of
(a) 10^3 kg/m^3 (b) 10^{10} kg/m^3
(c) 10^{15} kg / m^3 (d) 10^{17}kg/m^3
J&K Board-2021

Ans. (d) :

13. How many electrons are contained in $_{92}U^{238}$ nucleus?
(a) 92 (b) 146
(c) 238 (d) 0
Uttarakhand Board-2023

Ans. (a) :

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14. **'A' in nucleus $^{A}_{Z}X$ is**

(a) atomic number (b) mass number
(c) number of protons (d) number of electrons

Bihar Board-2021

Ans. (b) :

15. **The function of moderator in nuclear reactor is to**

(a) Slow the speed of neutrons
(b) Fast the speed of neutrons
(c) Slow the speed of electrons
(d) Fast the speed of electrons

Bihar Board-2023

Ans. (a) :

16. **The nucleus of any atom is made up of**

(a) proton (b) proton and electron
(c) α-particle (d) proton and neutron

Bihar Board-2023

Ans. (d) :

Section-B (Very Short Answer)

17. **Mention the constituents of the nucleus of an atom.**

Meghalaya Board-2015

18. **The density of the nucleus is of the order of.....**

J&K Board-2014

19. **Two nuclei have mass numbers in the ratio 1 : 27. What is the ratio of nuclear density?**

Haryana Board-2022

20. **One atomic mass unit is equal to 1.67×10^{-27} g. (Yes/No)**

Bihar Board-2021
Punjab Board-2018

21. **Calculate the radius of $^{197}_{79}Au$ nucleus.**

Tamil Nadu Board-2022

22. **What are the uses of nuclear reactors?**

Tamil Nadu Board-March, 2016
Tamil Nadu Board-2011

23. **Write any three properties of neutrons.**

Tamil Nadu Board-2011

24. **Explain the stability of a nucleus.**

Gujarat Board- May, 2021

25. **Neutron in a nucleus is discovered by……..**

MP Board-2020

26. **What is called nuclear force? Write the characteristics of nuclear force (any two)**

Odisha Board-2020, 2022, 2023
Rajasthan Board-2022
Chhattisgarh Board-2021
Kerala Board-2021
CBSE-2019
Karnataka Board-2018

27. **Define atomic mass unit (a.m.u). Express its value in kg and MeV.**

Nagaland Board-2018
UP Board-2017
J&K Board-2012

28. **An electron in hydrogen atom makes 6.0×10^{15} cycles per second round the nucleus. What will be the value of current at a point on the circular part ? The charge on electron = 1.6×10^{-19} coulomb.**

UP Board-2019

29. **Structures of a few atomic nuclei are as following. Select isotopic and isobaric nuclei with reason 8p + 8n , 8p + 9n, 18p + 22n and 20p + 20n.**
Where p and n are protons and neutrons respectively.

UP Board-2021

30. **Define 'unified atomic mass unit'.**

ISC-2009

31. **Draw a graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Indicate the region in which the nuclear force is (a) attractive and (b) repulsive.**

CBSE-2023

32. **Show that the density of a nucleus is independent of its mass number. Why are lighter nuclei more stable than heavier nuclei ?**

CBSE-2023

33. **(a) Determine from the given data, whether the following reaction is exothermic or endothermic**

$$^{226}_{88}Ra \longrightarrow ^{222}_{86}Rn + ^{4}_{2}He$$

Atomic masses : $m\left(^{226}_{88}Ra\right) = 226.02540\,u$

$m\left(^{222}_{86}Rn\right) = 222.01750\,u$

$m\left(^{4}_{2}He\right) = 4.002603\,u$

(b) What is the ratio of the nuclear density of $^{4}_{2}He$ and $^{14}_{7}N$?

CBSE-2022

34. **(a) Determine from the given data, whether the following reaction is exothermic or endothermic:**

$$^{12}_{6}C + ^{12}_{6}C \longrightarrow ^{20}_{10}Ne + ^{4}_{2}He$$

Atomic masses : $m\left(^{4}_{2}H_e\right) = 4.002603\,u$

$m\left(^{12}_{6}C\right) = 12.000000\,u$

$m\left(^{20}_{10}Ne\right) = 19.992439\,u$

(b) What is the ratio of the nuclear density of the phosphorus $^{30}_{15}P$ and nitrogen $^{14}_{7}N$?

CBSE-2022

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35. A neutron is bombarded on a $^{10}_{5}B$ nucleus and alpha particle is emitted. The nuclear reaction involved is

$^{1}_{0}n + ^{10}_{5}B \rightarrow ^{4}_{2}He + ...$

CBSE-2020

36. Name the particle emitted spontaneously in the following nuclear reaction:

$^{32}_{15}P \rightarrow ^{32}_{16}S + \bar{v} + _____$

CBSE-2020

37. The nuclear radius of $^{27}_{13}Al$ is 3.6 firmi. Find the nuclear radius of $^{64}_{29}Cu$.

CBSE-2020

38. The sequence of successive decay of a radioactive nucleus is shown as under :

$D_1 \xrightarrow{x} D_2 \xrightarrow{\beta^-} D_3$

If the atomic number and mass number of D_1 are 72 and 180 and those of D_3 are 71 and 176 respectively, identify the particle x.

CBSE-2020

39. A certain radioactive substance has a half-life of 30 days. What is the disintegration constant ?

Meghalaya Board-2017

40. How is the radius of a nucleus related to its mass number ?

Meghalaya Board-2017

41. State the characteristics of nuclear force.

Odisha Board-2022

42. The decay of proton to neutron is possible only inside the nucleus. Why?

Karnataka Board-July, 2018

43. $_{92}U^{238}$ Undergoes α-decay giving rise to thorium. What is the mass number of the daughter nuclide?

Karnataka Board-July, 2018

44. What is the ratio of the nuclear densities of two nuclei having mass numbers in the ratio 1:3?

Karnataka Board-July, 2016

26. What is a polar molecule ? Give an example.

Tamil Nadu Board-2018

Section-C (Short Answer)

45. Explain the process of release of energy in a nuclear reactor. Draw a schematic diagram of a nuclear reactor and write the function of each part.

AP Board-2020, 2021, 2023
Nagaland Board-2018, 2020
CBSE-2019
Telangana Board - 2015, 2018

46. What are isotopes, isobars and isotones ? Given one example for each.

CBSE-2019, 2022
Nagaland Board-2021
Bihar Board-2021
Jharkhand Board-2019
Karnataka Board-March, 2016
Karnataka Board-July, 2014
Meghalaya Board-2013

47. Classify nucleus on the basis of atomic number and mass number and define them.

UP Board-2023

48. Why is the mass of a nucleus always less than the sum of the masses of its constituents? Write one example to justify your answer.

(a) Classify the following six nuclides into (i) isotones, (ii) isotopes, and (iii) isobars:

$^{12}_{6}C, ^{3}_{2}He, ^{198}_{80}Hg, ^{3}_{1}H, ^{197}_{79}Au, ^{14}_{6}, ^{14}_{6}C$

(b) How does the size of a nucleus depend on its mass number? Hence explain why the density of nuclear matter should be independent of the size of the nucleus.

CBSE-2019

49. Why is it difficult to detect the presence of an anti-neutrino during β-decay? Define the term decay constant of a radioactive nucleus and derive the expression for its mean life in terms of the decay constant.

OR

Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their separation. Mark the regions on the graph where the force is (i) attractive, and (ii) repulsive.

CBSE-2019

50. Show that density of nucleus is independent of its mass number A.

CBSE-2019

51. Draw a plot showing the variation of potential energy of two nucleons as a function of distance between them. Identify the regions in which the force between the nucleons is (i) attractive, and (ii) repulsive. Justify your answers.

CBSE-2019, 2020, 2023

52. (a) Determine from the given data, whether the following reaction is exothermic or endothermic

$$^{1}_{1}H + ^{3}_{1}H \longrightarrow ^{2}_{1}H + ^{2}_{1}H$$

Atomic masses : $m\left(^{2}_{1}H\right) = 2.014102\,u$

$m\left(^{3}_{1}H\right) = 3.016049\,u$

$m\left(^{1}_{1}H\right) = 1.007825\,u$

(b) What is the ratio of the nuclear density of the gold isotope $^{197}_{79}Au$ and the silver isotope $^{107}_{47}Ag$.

CBSE-2022

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53. **(a) The density of the nuclear matter is tremendously larger than the physical density of the material. Explain.**

(b) The nuclear forces are not coulomb forces between nucleons. Explain.

CBSE-2020

54. **The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. Calculate the radii of n = 2 and n = 3 orbits.**

Given, $r_n = (n^2/m)\,(h/2\pi)^2\, 4\pi\varepsilon_0/e^2$

Assam Board-2023

55. **By which process does a Cobalt nucleus change into an Nickel nucleus?**

Assam Board-2017

56. **A radioactive mother nucleus emits a β-particle. Are the mother and daughter nuclei isotone or isobar?**

Meghalaya Board-2015

57. **Compare the radii of the nuclei of mass numbers 27 and 64.**

AP Board-2020, 2021, 2023

Telangana Board - 2015, 2018

58. **If one microgram $_{92}U^{235}$ is completely destroyed in an atom bomb, how much energy will be released?**

AP Board-2023, 2021

Section-D (Long Answer)

59. **(a) State the four conservation laws for nuclear reactions.**

(b) Write an equation for the nuclear reaction, when $^{238}_{92}U$ nucleus absorbs a neutron. Why does it becomes β-active after absorbing the neutron?

(c) Complete the following equations of nuclear reactions :

(i) $^{19}_{9}F + ^{1}_{1}H \rightarrow ^{16}_{8}O + ?$

(ii) $^{63}_{29}Cu + ^{2}_{1}D \rightarrow ^{64}_{30}Zn + ?$

NIOS-2012

60. **In what respect does a nuclear reaction differ from a chemical reaction? State the four conservation laws for nuclear reactions.**

NIOS-2016

IV. Mass Energy, Nuclear Binding Energy, packing Factor and Mass Defect

Section-A (Multiple Choice Questions)

61. **Positive rays of the same element produce two different traces in a Bainbridge mass spectrometer. The positive ions have :**

(a) same mass with different velocity
(b) same mass with same velocity
(c) different mass with same velocity
(d) different mass with different velocity

Tamil Nadu Board-September, 2016

Ans. (c) :

62. **The mass defect of a certain nucleus is found to be 0.03 amu. Its binding energy is:**

(a) 27.93 eV (b) 27.93 KeV
(c) 27.93 MeV (d) 27.93 GeV

Tamil Nadu Board-March, 2017, 2016

Ans. (c) :

63. **The binding energy per nucleon of $_{26}F^{56}$ nucleus is:**

(a) 8.8 MeV (b) 88 MeV
(c) 493 MeV (d) 413 MeV

Tamil Nadu Board-2015, 2011

Ans. (a) :

64. **The binding energy per nucleon is almost constant for the nuclei having atomic mass number——.**

(a) 30 < A < 240 (b) 30 < A < 170
(c) 170 < A < 230 (d) 156 < A < 192

Gujarat Board- March, 2020

Ans. (b) :

65. **According to mass energy equivalence relation, 9×10^{13} J of energy can be converted into ____ maximum mass.**

[Speed of light $c = 3 \times 10^8$ m/s]

(a) 81 g (b) 9 g
(c) 3 g (d) 1 g

Gujarat Board-2023

Ans. (d) :

66. **The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for helium nucleus. This implies that helium nucleus is**

(a) radioactive
(b) unstable
(c) easily fissionable
(d) more stable nucleus than its neighbours

CBSE-2023

Ans. (d) :

67. **When the nuclei ($A \leq 10$) fuse together to form a heavier nucleus, the**

(a) binding energy per nucleon increases.
(b) binding energy per nucleon decreases.
(c) binding energy per nucleon does not change.
(d) total binding energy decreases

CBSE-2020

Ans. (a) :

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68. The nature of strong nuclear force is
(a) repulsive and long-range
(b) repulsive and short-range
(c) attractive and long-range
(d) attractive and short-range

Odisha Board-2023

Ans. (d) :

69. The average binding energy per nucleo is maximum for the nucleus of
(a) helium (b) carbon
(c) iron (d) lead

Odisha Board-2022

Ans. (c) :

Section-B (Very Short Answer)

70. Write an expression for the mass defect of a nucleus having atomic number Z and atomic mass number A respectively.

Meghalaya Board-2013

71. Mass defect is difference between…….

(Fill in the blank)

J&K Board-2020

72. The nuclear radius depends upon the mass number as $A^{1/3}$. While as nuclear density is independent of mass number. (True/False)

J&K Board-2019

73. Explain the binding energy curve (graph is not necessary).

Gujarat Board-July, 2022
J&K Board-2012, 2014, 2015, 2018
Tamil Nadu Board-September, 2016

74. Define binding energy. Sketch the graph between binding energy per nuclear and mass number.

J&K Board-2023
Rajasthan Board-2022
CBSE-2019
ISC-2017
J&K Board-2016

75. Give the characteristics of Binding energy curve.

76. Mass of an electron is 9.11×10^{-31} kg. Calculate mass-energy of electron in Joule as well as electron volts. Given that speed of light in vacuum $C = 3.0 \times 10^8\ ms^{-1}$ and $1ev = 1.60 \times 10^{-19}J$.

Nagaland Board-2018

77. Calculate the binding energy per nucleon for $^{20}_{10}Ne$. Given that $m_H = 1.007825u$, $m_n = 1.008665u$ and mass of $^{20}_{10}Ne$ atom = 19.992440u.

Nagaland Board-2018

78. What is the minimum energy which a gamma ray photon must possess in order to produce electron-positron pair ?

ISC-2017

79. How much energy will be created if 1 g of matter is destroyed completely ?

ISC-2010

80. With the help of a suitable example and an equation, explain the term pair production.

ISC-2015

81. The atomic mass of Uranium $^{238}_{92}U$ is 238.0508 u while that of Thorium $^{234}_{90}Th$ is 234.0436 u and that of Helium $^{4}_{2}H$ is 4.0026u, Alpha decay converts $^{238}_{92}U$ into $^{234}_{90}Th$ as shown

$$^{238}_{92}U \longrightarrow ^{234}_{90}Th + ^{4}_{2}He + \text{energy}$$

Determine the energy released in this reaction.

ISC-2014

82. Which property of nuclear force explains the constancy of binding energy per nucleon $\left(\frac{BE}{A}\right)$ for nuclei in the range 20 < A < 170 ?

CBSE-2019

83. (a) Calculate the binding energy of an alpha particle in MeV. Given
mass of a proton = 1.007825 u
mass of a neutron = 1.008665 u
mass of He nucleus = 4.002800 u
$1u = 931\ MeV/c^2$

OR

(b) A heavy nucleus P of mass number 240 and binding energy 7.6 MeV per nucleon splits into two nuclei Q and R of mass number 110 and 130 and binding energy per nucleon 8.5 MeV and 8.4 MeV respectively. Calculate the energy released in the fission.

CBSE-2023

84. Draw the graph showing the variation of binding energy per nucleon with mass number A of nuclei (2 < A < 170). Use this graph to explain the release of energy in nuclear fission.

CBSE-2023

85. Draw a graph showing the variation of binding energy per nucleon as a function of mass number A. The binding energy per nucleon for heavy nuclei (A>170) decreases with the increase in mass number. Explain.

CBSE-2023

86. Define the term, mass defect. How is it related to stability of the nucleus?

CBSE-2023
Tamil Nadu Board-September, 2018, 2016, 2012
Meghalaya Board-2017

87. Calculate the energy released in MeV in the following reaction :

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + n$$

Given : $m\left(^{2}_{1}H\right) = 2.014102u$

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$m\left({}_1^3H\right) = 3.016049u$

$m\left({}_2^4He\right) = 4.002603u$

$M_n = 1.008665$ u

CBSE-2022, 2020

88. Draw the curve showing the variation of binding energy per nucleon with the mass number of nuclei. Using it explain the fusion of nuclei lying on ascending part and fission of nuclei lying on descending part of this curve.

CBSE-2020

89. Draw the plot of the binding energy per nucleon as a function of mass number for different nuclei. The nuclei lying at the middle flat portion of the curve are more stable. Explain.

90. Calculate the energy released in the nuclear reaction shown below:

$${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + \text{Energy}$$

$$\text{mass of}\left({}_1H^2\right) = 2.014102\,u$$

$$\text{mass of}\left({}_2He^4\right) = 4.0026\,u$$

1 a.m.u = 931 MeV

Kerala Board-2016

91. The binding energies of ${}_8O^{16}$ and ${}_{17}Cl^{35}$ are 127.35 MeV and 289.3 MeV respectively. Calculate the binding energy per nucleon of ${}_8O^{16}$ and ${}_{17}Cl^{35}$ and state which of the two nuclei is more stable.

Meghalaya Board-2023

92. Calculate the energy equivalent of 1 gm. of substance.

Uttarakhand Board-2022
MP Board-2020

Section-C (Short Answer)

93. Find the energy released when two ${}_1H^2$ nuclei fuse together to form a single ${}_2He^4$ nucleus. Given, the binding energy per nucleon of ${}_1H^2$ and ${}_2He^4$ are 1.1 MeV and 7.0 MeV respectively.

Tamil Nadu Board-2018

94. Calculate the binding energy and binding energy per nucleon of ${}_{20}Ca^{40}$ nucleus. Given :
mass of 1 proton = 1.007825 amu
mass of 1 neutron = 1.008665 amu
mass of ${}_{20}Ca^{40}$ nucleus = 39.96259 amu

Tamil Nadu Board-2016

95. What are the important inferences from the average binding energy curve?

Tamil Nadu Board-2023

96. At what temperature will the average molecular kinetic energy in gaseous hydrogen be equal to the binding energy of a hydrogen atom? Boltzmann constant $k_B = 1.38\times10^{-23}Jk^{-1}$.

Gujarat Board- May, 2021

97. Write mass-energy relation.

MP Board-2020

98. Explain the meanings of the following :
(i) Nuclear Force
(ii) Decay constant
(iii) Mass Defect

Chhattisgarh Board-2023
Assam Board-2014

99. Draw a graph showing the variation of binding energy per nucleon vs. mass number A. In the graph, mark the region where nuclear fusion occurs. Also write the Mass Number Range.

Chhattisgarh Board-2019

100. Define mass defect associated to a nucleus. Show that 1 a.m.u. (atomic mass unit) is equivalent to 931.5 Mev of energy.

Meghalaya Board-2021
NIOS-2019

101. Calculate mass defect and binding energy per nucleon of ${}_{10}^{20}Ne$, given

Mass of ${}_{10}^{20}Ne = 19.992397\,u$

Mass of ${}_1^1H = 1.007825$ u

Mass of ${}_0^1n = 1.008665$ u

ISC-2017

102. In the following nuclear reaction, calculate the energy released in MeV

$${}_1^2H + {}_1^2H \longrightarrow {}_2^3He + {}_0^1n$$

given that, mass of ${}_1^2H$ = 2.015 u, mass of ${}_2^3He$ = 3.017 u, mass of ${}_0^1n$ = 1.009 u.

ISC-2011

103. The following equation represents a fusion reaction

$${}_1^2H + {}_1^3H \longrightarrow {}_2^4He + {}_0^1n + Q$$

where, Q is the energy released.
Mass of ${}_1^2H$ atom = 2.014102 u, mass of ${}_1^3H$ atom = 3.016050 u, mass of ${}_2^4He$ atom = 4.002603 u and mass of neutron, ${}_0^1n$ =1.008665 u. Calculate the value of Q.

ISC-2006

104. The nucleus ${}_{92}^{235}Y$, initially at rest decays into ${}_{90}^{231}X$ by emitting an α - particle

$${}_{92}^{235}Y \longrightarrow {}_{90}^{231}X + {}_2^4He + \text{energy}.$$

The binding energies per nucleon of the parent nucleus, the daughter nucleus and α - particle are 7.8 MeV, 7.835 MeV and 7.07 MeV, respectively. Assuming the daughter nucleus to be formed in the unexcited state and neglecting its share in the energy of the reaction, find the speed of the emitted α - particle. (Mass of α - particle = 6.68×10^{27} kg).

CBSE-2020

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105. How much energy should be given to uranium to eject one proton from its nucleus?
Given,
$^{238}_{92}U = 238.05079 amu$
$^{237}_{91}Pa = 237.05121 amu$
$^{1}_{1}H = 1.00783 amu, 1 amu = 931.5 MeV$
Assam Board-2016

106. Obtain the binding energies of the nuclei $^{56}_{26}Fe$ and $^{209}_{83}Bi$ in units of MeV from the given data
$m_H = 1.007825 amu$
$m_n = 1.008665 amu$
$m\left(^{56}_{26}Fe\right) = 55.934939 amu$
$m\left(^{209}_{83}Bi\right) = 208.980388 amu$
1 amu = 931.5 Mev
Which nucleus has greater binding energy per nucleon?
Assam Board-2015

107. Find the binding energy per nucleon of an α-particle in Mev. (Take, 1 a.m.u = 931.5 MeV)
Given-
mass of α-particle = 4.00150 a.m.u.
mass of proton = 1.00728 a.m.u
mass of neutron =1.00867 a.m.u.
Meghalaya Board-2018

108. Calculate the binding energy per nucleon for $_{30}Zn^{64}$ in MeV (Take 1 a.m.u = 931 MeV)
Given,
Mass of proton = 1.00728 a. m. u.
Mass of neutron = 1.00867 a. m. u.
Mass of $_{30}Zn^{64}$ = 63.9423 a. m. u.
Meghalaya Board-2023

109. Show that the volume of a nucleus is directly proportional to its mass number.
Meghalaya Board-2014

110. Define mass defect and binding energy of a nucleus, and write the relation between them.
Odisha Board-2023
NIOS-2016

111. Find the per nucleon binding energy of alpha particle, while the actual mass is 4.00389 amu. [mass of proton m_p = 1.00813 amu, mass of neutron m_n = 1.00893 amu, amu = 931 MeV]
Uttarakhand Board-2023

Section-D (Case-Based Questions)

112. Calculate the binding energy per nucleon for $^{64}_{30}Zn$ in MeV. (Take 1 a. m. u. = 931 Mev)
Given
Mass of proton = 1.007825 a. m. u.
Mass of neutron = 1.008665 a. m. u
Mass of $^{64}_{30}Zn$ = 63.9423 a. m. u.
Meghalaya Board-2015

Section-E (Long Answer)

113. Explain the terms: Nuclear binding energy, half life period for any radioactive element.
Haryana Board-2018
Karnataka Board-March, 2015

114. Prove that the nuclear density is same for all nuclei and is independent of its mass number A.
Meghalaya Board-2021

115. A copper coin has a mass of 63.0g. Calculate the nuclear energy that would be required to separate all the neutrons and protons form each other. The coin is entirely made of $^{63}_{29}Cu$ atoms.
Mass of $^{63}_{29}Cu$ atom = 62.92960 u
Mass of proton = 1.00727u
Mass of neutron = 1.00866 u
Avogadro's number = 6.022×10^{23}
Karnataka Board-March, 2020
Karnataka Board-July, 2019

116. Calculate the binding energy and binding energy per nudeon of an Alpha (α) particle in MeV from the following data:
Mass of α -particle nucleus = 4.00260u
Mass of neutron = 1.008662 u.
Mass of proton = 1.007825 u.
Karnataka Board-July, 2020

117. Calculate the binding energy and binding energy per nucleon (in MeV) of a nitrogen nucleus $\left(^{14}_{7}N\right)$ from the following data:
Mass of proton = 1.0078 u
Mass of neutron = 1.00867 u
Mass of nitrogen nucleus = 14.00307 u
Karnataka Board-March, 2014
Assam Board-2014

III. Radioactivity and Decay Law

Section-A (Multiple Choice Questions)

118. Initial mass of $_{84}Po^{218}$ is 1 gram. After what time 0.875 gram of it will be disintegrated ? ($T_{1/2}$ = 3 minutes)
(a) 12 minutes (b) 6 minutes
(c) Infinity (d) 9 minutes
Tamil Nadu Board-2018

Ans. (d) :

119. The ionisation power is maximum for :
(a) γ-rays (b) Neutrons
(c) β-particles (d) α-particles
Tamil Nadu Board-2018

Ans. (d) :

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120. The half life period of N^{13} is 10.1 minutes. Its mean life time is:

(a) 5.05 minutes (b) 20.2 minutes

(c) $\frac{10.1}{0.6931}$ minutes (d) infinity

Tamil Nadu Board-March, 2016

Ans. (c) :

121. The radio-isotope used in agriculture is :

(a) $_{15}P^{31}$ (b) $_{15}P^{32}$

(c) $_{11}Na^{23}$ (d) $_{11}Na^{24}$

Tamil Nadu Board-2017

Tamil Nadu Board-March, 2016

Ans. (b) :

122. During the life of a radioactive element as time passes the number of its nuclei decreases and along with that ———.

(a) activity decreases but λ remains constant

(b) activity and λ go on increasing

(c) activity and λ go on decreasing

(d) Activity decreases but λ increases

Gujarat Board- May, 2021

Ans. (a) :

123. 1g radioactive element reduces to $\frac{1}{3}$g after 2 days. After total 6 days how mass remain?

(a) $\frac{1}{9}$g (b) $\frac{1}{6}$g

(c) $\frac{1}{27}$g (d) $\frac{1}{12}$g

Gujarat Board- May, 2021

Ans. (c) :

124. Tritium has half life of 12.5 years undergoing beta decay. What fraction of sample of tritium will remain undecayed after 50 years?

(a) $\frac{1}{2}$ (b) $\frac{1}{8}$

(c) $\frac{1}{16}$ (d) $\frac{1}{4}$

Gujarat Board- March, 2020

Ans. (c) :

125. The half-life of a radioactive element is 2 hr and that of the other is 4 hr. Their initial activities are equal. After 4 hr what will be the ratio of their activities?

(a) 1 : 3 (b) 1 : 4

(c) 1 : 2 (d) 1 : 1

Gujarat Board- March, 2019

Ans. (c) :

126. Half-life of a radioactive element is 5 min. At the end of 20 min. its.....% quantity will be disintegrated.

(a) 75 (b) 93.75

(c) 25 (d) 6.25

Gujarat Board- March, 2019

Ans. (b) :

127. For a radioactive element half life is 1.5 days. How many minutes will it take to disintegrate this element by 75% ?

(a) 3240 (b) 4320

(c) 1260 (d) 2430

Gujarat Board-2023

Ans. (b) :

128. Tritium has a half - life of 12.5 y undergoing beta decay. The fraction of a sample remain undecayed after 25 y is _____.

(a) $\frac{1}{8}$ (b) $\frac{1}{4}$

(c) $\frac{1}{2}$ (d) $\frac{1}{16}$

Gujarat Board-March, 2022

Ans. (b) :

129. Mean life of a radioactive sample is 100 second (s). Then its half life is

(a) 6.93 s (b) 0.693 s

(c) 69.3 s (d) 100 s

Jharkhand Board-2023

Ans. (c) :

130. Half life of a radioactive element is 8 days. In how much time will its mass reduce to 1/8th of its original value ?

(a) 1 days (b) 64 days

(c) 3 days (d) 24 days

NIOS-2022

Ans. (d) :

131. If the activity of a radioactive sample drops to 1/16th of its initial value in 3 hours, It's half life is :

(a) $\frac{3}{16}$hours (b) $\frac{3}{8}$hours

(c) $\frac{3}{4}$hours (d) $\frac{3}{2}$hours

NIOS-2018

Ans. (c) :

132. In β^- decay, a

(a) neutron converts into a proton emitting antineutrino.

(b) neutron converts into a proton emitting neutrino.

(c) proton converts into a neutron emitting antineutrino.

(d) proton converts into a neutron emitting neutrino.

CBSE-2020

Ans. (a) :

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133. During the process of β^- decay,
(a) an atomic electron is ejected.
(b) an electron which was already present in the nucleus, is ejected.
(c) a neutron is converted into a proton and the created electron is ejected from the nucleus.
(d) a proton is converted into a neutron and the created electron is ejected from the nucleus.
CBSE-2020

Ans. (c) :

134. The time in which radioactive substance becomes half of its initial amount is called.
(a) average life (b) half - life
(c) time -period (d) decay constant
Bihar Board-2022, 2019

Ans. (b) :

135. Which of the following is correct for radioactive disintegration ?
(a) $N = N_o e^{\lambda.t}$ (b) $N = N_o e^{-\lambda.t}$
(c) $N = N_o e^{2\lambda.t}$ (d) $N = N_o e^{-2\lambda.t}$
Bihar Board-2021

Ans. (b) :

136. The unit of radioactivity is
(a) MeV (b) a.m.u
(c) curie (d) joule
Bihar Board-2023, 2022

Ans. (c) :

137. Which of the following has maximum penetrating power ?
(a) x-rays (b) cathode rays
(c) α-rays (d) γ-rays
Bihar Board-2023, 2022

Ans. (d) :

Section-B (Very Short Answer)

341. The average life of a 16 gm radioactive substance is one day. Calculate:
(i) Its half life time
(ii) Its undecayed amount after 3.5 days
UP Board-2020

138. In β - decay, the parent and daughter nuclei have the same number of ___.
CBSE-2020

139. What is Radioactive Decay constant?
J&K Board-2018

140. Write any three properties of X-rays.
Tamil Nadu Board-2018

141. Write any three properties of β rays.
Tamil Nadu Board-September, 2016

142. What is β-decay? Give an example.
Gujarat Board-2022
Gujarat Board-August, 2020
Tamil Nadu Board-March, 2016

143. The radioactive isotope $_{84}Po^{214}$ undergoes a successive disintegration of two α- decays and two β- decays. Find the atomic number and mass number of the resulting isotope.
Tamil Nadu Board-2015

144. State radioactive law of disintegration.
Tamil Nadu Board-2016

145. What are the properties of neutrino?
Tamil Nadu Board-2023
ISC Board-2014

146. Write the law of radioactive decay. The decay constant of a radioactive substance is 0.693 per minute . Calculate its half-life time in minute.
Rajasthan Board-2023

147. In a given sample, at some instant, the rate of disintegration of radioactive element is 8000 disintegration per second. At this instant, the number of undisintegrated nuclei of this element is 8×10^7. Find the decay constant.
Gujarat Board- May, 2021

148. Explain Alpha Decay ?
Gujarat Board- March, 2020

149. The half life of $^{238}_{92}U$ undergoing α-decay is 4.5×10^9 years. What is the activity of 1 g of sample of $^{238}_{92}U$?
Gujarat Board-2023

150. The reciprocal of decay constant is that time during which the number of active nuclei of radioactive substance reduces $\frac{1}{e}$ times of the initial value of number of nuclei. Prove it.
Chhattisgarh Board-2020

151. A radioactive substance is undergoing radioactive decay. What percentage of a given mass (m) or the substance will be left un-decayed after a time of four half-life periods?
NIOS-2016

152. Establish the relationship between half - life and decay constant.
UP Board-2019
NIOS-2018
ISC-2017
Haryana Board-2017, 2016

153. Write the relationship between the average life and half-life of a radioactive substance.
UP Board-2020

154. What is the minimum energy required to break a $_2He^4$ nucleus into free protons and neutrons? Masses of hydrogen atom, a neutron and $_2He^4$ atom in a.m.u. are 1.007825, 1.008665 and 4.002603 respectively.
UP Board-2022

155. Half-life of a certain radioactive element is 3.465 days. Find its disintegration constant.
ISC-2014

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156. The half-life of a certain radioactive element is 8 h. If disintegration starts with 32 g of this element, then how much of the sample will be left behind at end of one day ?

ISC-2009

157. Half-life of a certain radioactive substance is 13.89 days. What is the value of its disintegration constant ?

ISC-2009

158. The half-life of radon is 3.8 days. Calculate the amount of radon left undecayed in sample containing 1024 mg of radon after 38 days.

ISC-2005

159. Half-life of a certain radioactive substance is 6 h. If you had 3.2 kg of this substance in the beginning, how much of it will disintegrate in one day ?

ISC-2013

1. (f) What is the change of atomic number Z of a nucleus when it emits a β particle?

Assam Board-2013

160. Starting with $N = N_o e^{-\lambda t}$, obtain a relation between disintegration constant (λ) of a radioactive element and its half-life (T). Various terms have their usual meaning.

ISC-2010

161. Plot a graph showing the variation of number of undecayed nuclei in a radioisotope as a function for time. Hence define half life of a nucleus and obtain its relation with average life.

CBSE-2019

162. Complete the following nuclear reactions for α and β decay :

(i) ${}^{238}_{92}U \rightarrow ? + {}^{4}_{2}He + Q$

(d) ${}^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + ? + \nu$

CBSE-2019

163. (a) Define one Becquerel.

(b) A radioactive substance disintegrates into two types of daughter nuclei, one type with disintegration constant λ_1 and the other type with disintegration constant λ_2. Determine the half-life of the radioactive substance.

CBSE-2020

164. (a) Write the SI unit of activity of a radioactive substance.

(b) Find the half-life of a radioactive substance if the activity of the substance drops to $\frac{1}{8}$ of its initial value in 15 years.

CBSE-2020

165. (a) For a radioactive substance, show the variation of the total mass disintegrated as a function of time t graphically.

(b) Initial mass of a radioactive substance is 3.2 mg. It has a half-life of 4 h. Find the mass of the substance left undecayed after 8 h.

CBSE-2020

166. (a) Differentiate between half-life and average life of a radioactive substance.

(b) A radioactive substance decays for an interval of time equal to its mean life. Find the fraction of the amount of the substance which is left undecayed after this time interval.

CBSE-2020

167. Define the term 'Half-life' of a radioactive substance. Two different radioactive substances have half-lives T_1 and T_2 and number of undecayed atoms at an instant, N_1 and N_2, respectively. Find the ratio of their activities at that instant.

CBSE-2020

168. A radioactive substance is reduced to $\frac{1}{16}$ th of its original mass after 4 days. Find the critical mass of the substance so that 4 g of substance is left after 6 days.

CBSE-2020

169. Define 1 Curie unit of radio-activity. What do you mean by 'half life'?

Assam Board-2014

170. If you free a neutron from a nucleus, it will decay into three particles. Two of them are proton and electron. What is the third particle?

Assam Board-2017

171. Define half life of a radioactive sample. Write the equation that connects half life with disintegration constant.

Kerala Board-2021

Karnataka Board-2014

172. The half – life of Polonium is 140 days. How long will it take to reduce to 1 g. Polonium out of its initial mass of 16 g ?

Kerala Board-2016

173. A nucleus ${}_{z}X^{A}$ decays by β-emission to ${}_{7}N^{14}$. What are the values of z and A ?

Meghalaya Board-2017

174. Disintegration rate of a radio-active sample is 10^{10} per hour at 20 hours from the start. It reduces to 5×10^{9} per hour after 30 hours. Calculate the decay constant.

Maharashtra Board-2023

175. What is the ratio of speed of gamma rays and radiowaves in vacuum?

Goa Board-2019

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176. The half-life period of a radioactive substance is 30 days. what is the time taken for $3/4^{th}$ of the original mass to disintegrate?

J&K Board-2011

177. Write the relation between Half-Life and Mean-Life of radio active element.

Karnataka Board-March, 2019

178. Write the SI unit of activity.

Karnataka Board-March, 2017
Karnataka Board-July, 2015, 2020

179. State Curie's law.

Karnataka Board-July, 2015

180. If 2α particles and 3β particles emit in series decay of a radioactive nucleus $_{88}Ra^{228}$ and nucleus Y is obtained at last then find atomic number and mass number of Y.

Uttarakhand Board-2020

181. A radioactive substance reduces to 1/16 times of its initial amount in 500 years. Find the half - life of the radioactive substance?

Uttarakhand Board-2023

182. Which part of the atom emits radioactive radiations?

Uttarakhand Board-2023

183. The decay constant of a radioactive substance is 5.2×10^3 per year. Determine its half-life.

Bihar Board-2019, 2022

184. The decay constant of a radioactive substance is 5.2×10^3 per year. What is its half-life ?

Bihar Board-2023

Section-C (Short Answer)

185. Calculate the time required for 60% of a sample of radon to undergo decay. Given $T_{1/2}$ of radon = 3.8 days.

Tamil Nadu Board-2018

186. A piece of bone an archaeological site is found to give a count rate of 15 counts per minute. A similar sample of fresh bone gives a count rate of 19 counts per minute. Calculate the age of the specimen. Given $T_{1/2}$ = 5570 years.

Tamil Nadu Board-2016

187. Define the terms "half-life period" and "decay constant" of a radioactive sample. Derive the relation between them.

Rajasthan Board-2022
CBSE-2020,2022
J&K Board-2016, 2019
Haryana Board-2018
Nagaland Board-2018
Kerala Board-2016

188. State the law of radioactive decay. Derive an expression showing the variation of number of undecayed nuclei with time.

Haryana Board-2018, 2017

189. When a counter is brought near a patient injected with a radioactive dose, it records 16000 counts per minute. In equal circumstances, after 4 hours it records 500 counts per minute. Find the half time of a radioactive element in the given dose.

Gujarat Board- May, 2021

190. The half life of a radioactive element is 0.231 year. Calculate the time during which its activity becomes 10% of its initial activity.

Gujarat Board- July, 2022

191. Half-life of a certain radioactive material is 8h.
(i) Find disintegration constant of this material.
(ii) If one starts with 600g of this substance, how much of it will disintegrate in one day ?

ISC-2016

192. (i) What is meant by the term activity of a radioactive substance ?
(ii) A radioactive sample has a half-life of 1.4×10^{16}s and a mass number of 238. Calculate the number of disintegration of 1 g of this sample.

ISC-2006

193. (a) Write the relation between half life and average life of a radioactive nucleus.
(b) In a given sample two isotopes A and B are initially present in the ratio of 1:2. Their half lives are 60 years and 30 years respectively. How long will it take so that the sample has these isotopes in the ratio of 2 : 1 ?

CBSE-2019

194. Describe in brief the process of gamma radiation.

Assam Board-2015

195. Spontaneous and continuous disintegration of a nucleus of a heavy element with the emission of certain types of radiation is known as radioactivity.
(a) The radioactive isotope 'D' decays according to the sequence
$$D \xrightarrow{\beta^-} D_1 \xrightarrow{\alpha} D_2$$
If the mass number and atomic number of D_2 are 172 and 71 respectively, what are the (i) Mass number, (ii) Atomic number of D.
(b) State radioactive decay law.
(c) Write the relation connecting half-life and mean life of radioactive element.

Kerala Board-2020

196. In a nuclear reactor the chain reaction is carried out under controlled conditions.
(a) Name the materials that is used as control rods in a nuclear reactor.

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(b) Average energy of a neutron produced in fission of $^{235}_{92}U$ nucleus is ____.

(c) Write down the reactions involved in the conversion of $^{238}_{92}U$ to $^{239}_{94}Pu$ in a nuclear reactor.

Kerala Board-2013

197. (a) A and B are two isotopes having mass numbers 14 and 16 respectively. If the atomic number of A is 7, then how many neutrons will be there in B?

(b) The half-life period of a radioactive material is 5 hours. In how much time $\frac{15}{16}$ of the material will decay?

Kerala Board-2017

198. What is half-life of a radioactive nucleus? Show that half-life is inversely proportional to the decay constant of the radioactive sample.

Meghalaya Board-2014, 2018

199. A radioactive isotope decays in the following sequence:

$$A \xrightarrow{\beta} A_1 \xrightarrow{\alpha} A_2$$

If the mass number and atomic number of A_2 are 176 and 71 respectively, find the mass number and atomic number of A_1 and A. Which of the three elements are isobars?

Meghalaya Board-2014

200. State the law of radioactive decay. Hence derive the relation $N = N_0e^{-\lambda t}$. Represent it graphically.

Meghalaya Board-2019, 2013
Maharashtra Board-2019
Karnataka Board-March, 2017
Nagaland Board-2017
ISC-2011

OR

What is radioactivity? State radioactive decay law and show that it is exponential in nature.

Assam Board-2023
Odisha Board-2022
Haryana Board-2016
Punjab Board-2018
Karnataka Board-March, 2014

OR

Using the equation $N = N_0e^{-\lambda T}$, obtain the relation between half-life (T) and decay constant (λ) of a radioactive substance.

Tamil Nadu Board-2015
ISC-2011, 2015, 2005
NIOS-2019

201. When plutonium $\left(^{242}_{94}Pu\right)$ undergoes α - decay an isotope uranium is obtained. Write the equation for this unclear reaction. A radioactive nucleus undergoes a series of decays according to the following reactions. Find the mass number and atomic number C.

$$^{60}_{27}A \xrightarrow{\beta^-} B \xrightarrow{\gamma^-} C.$$

Goa Board-2023

202. Using the equation representing law of radioactive decay, obtain an equation to show that half-life of a radioactive substance is equal to 0.693 times its average life.

Goa Board-2019

203. Derive the expression for the half-life of a radioactive nuclide.

Karnataka Board-July, 2018

204. A radioactive material reduces to $\frac{1}{16}$th of its initial value in 500 years. Find the half life of radioactive material. 3

Uttarakhand Board-2019

Section-D (Long Answer)

205. In a sphere of 10^2 m radius, radioactive material emits β^--particles at the rate of $5\times10^7 s^{-1}$. If 40% of these emitted β^--particles escape from the sphere, how long would it take to raise the potential of the sphere from 0 to 16V? (Take $K = 9\times10^9$ SI unit)?

Gujarat Board- March, 2019

206. Derive the exponential law for radioactive disintegration. Also draw the decay curve.

Gujarat Board-March, 2022

207. Derive $I + e = A + \delta$ for a triangular glass prism. Also write the condition for the angle of minimum deviation. Derive the formula for the refractive index of the material of the prism.

Gujarat Board-March, 2022

208. (a) Derive the law of radioactive decay $N = N_0e^{-\lambda t}$

(b) The half life of $^{238}_{92}U$ undergoing α-decay is 4.5×10^9 years. Find its mean life.

(c) What fraction of the initial mass of a radioactive substance will decay in five half-life periods?

CBSE-2020

209. What is half-life of a radioactive nucleus ? How is it related to disintegration constant ?

Meghalaya Board-2017

210. (a) The energy levels of an atom are as shown in figure below. Which of them will result in the transition of a photon of wavelength 275 nm?

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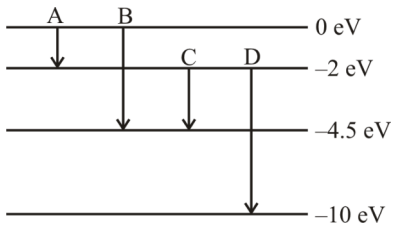

(b) Which transition corresponds to emission of radiation of (i) maximum wavelength and (ii) minimum wavelength?

CBSE Foreign-2013

211. Determine the mass Na^{22} which has an activity of 5mCi. Half life of Na^{22} is 2.6 years.
Avogadro number – 6.023×10^{23} atoms.

Karnataka Board-March, 2015

212. Half life of U-238 undergoing α - decay is 4.5×10^9 years. What is the activity of one gram of U-238 sample?

Karnataka Board-March, 2019

213. The half life of a radioactive sample $_{38}Sr^{90}$ is year. Calculate the rate of disintegration of 15 mg of this isotope.
Given Avogadro number = 6.023×10^{23}.

Karnataka Board-July, 2018

214. The activity of a radioactive substance is 4700 per minute. Five minute later the activity is 2700 per minute. Find a) decay constant) half-life of the radioactive substance.

Karnataka Board-July, 2016

215. Calculate the half life and mean life of Radium -226 of activity 1Ci; Given the mass of Radium -226 is 1 gram and 226 gram of radium consists of 6.023×10^{23} atoms.

Karnataka Board-July, 2015

IV. Nuclear Fission and Fusion

Section-A (Multiple Choice Questions)

216. The explosion of atom bomb is based on the principle of :
(a) Fusion reaction
(b) Uncontrolled fission reaction
(c) Thermonuclear reaction
(d) Controlled fission reaction

Tamil Nadu Board-2018, 2015

Ans. (b) :

217. Solar energy is mainly caused due to
(a) fission of uranium present in the sun
(b) fusion of protons during synthesis of heavier elements
(c) gravitational contraction
(d) burning of hydrogen in oxygen

Nagaland Board-2017

Ans. (b) :

218. The reaction responsible for energy generation in the Sun is :
(a) a chemical reaction
(b) a controlled fission reaction
(c) an uncontrolled fission reaction
(d) fusion reaction

NIOS-2017

Ans. (d) :

219. The approximate energy produced during the fusion of four hydrogen nuclei into one helium nucleus is
(a) 1 MeV (b) 10 MeV
(c) 25 MeV (d) 1000 MeV

Odisha Board-2022

Ans. (c) :

Section-B (Very Short Answer)

220. Complete the nuclear reaction
$_3Li^7 + ? \rightarrow {}_3Li^7 + {}_1H^2$

J&K Board-2017

221. When nuclear fission and fusion reactions occur, what decreases in both the cases?

J&K Board-2016

222. Define the following
(i) nuclear fusion
(ii) nuclear fission
(iii) mass defect

Rajasthan Board-2023

223. Explain nuclear fusion reaction with an example.

Bihar Board-2021
J&K Board-2018, 2022
Haryana Board-2016, 2018
Chhattisgarh Board - 2022

224. Why nuclear fusion reaction is also called thermo-nuclear reactions ?

ISC-2017

225. In a nuclear reactor, what is the function of a moderator ?

ISC-2016

226. Where in our universe is the thermo-nuclear energy being released naturally ?

ISC-2016, 2009

227. Write any one balanced equation representing nuclear fission.

ISC-2015, 2014

228. Consider the following nuclear reaction,

$$^2_1H + ^2_1H \longrightarrow ^3_2He + ^1_0n$$

What is the name of this reaction ?

ISC-2011

229. Complete the following nuclear reaction

$$^1_0n + ^{12}_6C \longrightarrow ^{11}_5B + ...$$

ISC-2010

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230. What is the source of energy of stars ?

ISC-2008

231. What is the role of control rods in a nuclear reactor ?

ISC-2004

232. What is the function of heavy water in a nuclear reactor ?

ISC-2002

233. Identify the nuclides X and Y in the nuclear reactions.

$_5B^{11} + {}_1H^1 \rightarrow {}_4Be^8 + X$ and $_6C^{14} \rightarrow Y + {}_{-1}e^0$

ISC-2001

234. Fission of U-235 nucleus releases 200 MeV of energy. Calculate the fission rate (i.e., number of fissions per second) in order to produce a power of 320 MW.

ISC-2009

235. Complete the following nuclear reactions:

(i) $^{32}_{15}P \rightarrow {}^{A}_{Z}X + e^- + \bar{v}$

(ii) $^{12}_{6}C + {}^{12}_{6}C \rightarrow {}^{A}_{Z}Y + {}^{4}_{2}He$

CBSE-2019

236. Distinguish between nuclear fusion and nuclear fussion. Give one example for each.

Uttarakhand Board-2022
J&K Board-2021,2020, 2017
MP Board-2020
CBSE-2019
Haryana Board-2017

237. Briefly describe the multi-step process involved in the generation of energy in the Sun.

CBSE-2023

238. In a fission event of $^{238}_{92}U$ by fast moving neutrons, no neutrons are emitted and final products, after the beta decay of the primary fragments, are $^{140}_{58}Ce$ and $^{99}_{44}Ru$. Calculate Q for this process. Neglect the masses of electrons/positrons emitted during the intermediate steps.

Given :

$m\left(^{238}_{92}U\right) = 238.05079u; m\left(^{140}_{58}Ce\right) = 139.90543u$

$m\left(^{99}_{44}Ru\right) = 98.90594u; m\left(^{1}_{0}n\right) = 1.008665u$

CBSE-2022

239. Calculate for many years will the fusion of 2.0 kg deuterium keep 800 W electric lamp glowing. Take the fusion reaction as

$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}He + {}^{1}_{0}n + 3.27\,MeV$

CBSE-2020

240. A heavy nucleus P of mass number 240 and binding energy 7.6 MeV per nucleon splits in to two nuclei Q and R of mass numbers 110, 130 and binding energy per nucleon 8.5 MeV and 8.4 MeV, respectively. Calculate the energy released in the fission.

CBSE-2020

241. Complete the nuclear reaction-

$_2He^4 + {}_Z X^A \rightarrow {}_{Z+2}Y^{A+3} + \square$

Assam Board-2014

242. Match the following:

	A	B
i.	Nuclear fission	β-decay
ii.	Nuclear fusion	Hydrogen spectrum
iii.	Transition between atomic energy levels	Nuclei with low atomic numbers
iv	Electron emission from nucleus	Generally possible for nuclei with high atomic number
		Photo electric emission

Kerala Board-2020

243. (a) In the hypothetical fission reaction $_{92}X^{236} \rightarrow {}_a Y^{144} + {}_{36} Z^b + 3\,{}_0n^1$ what are the values of a and b?

(b) Write down the relation between 'mass defect' and 'binding energy'

Meghalaya Board-2023

244. In the following nuclear reaction, identify the particle X. $n \rightarrow p + e^- + X$

Karnataka Board-March, 2016

Section-C (Short Answer)

245. A reactor is developing energy at the rate of 32 MW. Calculate the required number of fissions per second of $_{92}U^{235}$. Assume that energy per fission is 200 MeV.

Tamil Nadu Board-2011

246. Explain the following in a nuclear reactor based on thermal neutron fission:

(i) The moderator

(ii) The coolant

Draw a block diagram of this reactor.

Rajasthan Board-2022

247. What is nuclear chain reaction? State any two difficulties arising against sustaining a chain reaction. Also write the necessary precautions.

Gujarat Board-March, 2022

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248. Complete the following equations :

(i) ${}_{80}Hg^{200} + {}_{1}H^{1} \longrightarrow {}_{79}Au^{197} + ...$

(ii) ${}_{4}Be^{9} + {}_{2}He^{4} \longrightarrow {}_{0}n^{1} + ...$

(iii) ${}_{92}U^{238} \longrightarrow {}_{2}He^{4} + ...$

(iv) ${}_{13}Al^{27} + {}_{2}He^{4} \longrightarrow {}_{15}P^{30}$

UP Board-2017

249. In a certain star, three α-particle undergo fusion in a single reaction to form ${}^{12}_{6}C$ nucleus. Calculate the energy released in this reaction in MeV.

Given, $m\left({}^{4}_{2}He\right) = 4.002604\,u$ and

$m\left({}^{12}_{6}C\right) = 12.000000\,u.$

ISC-2013

250. (i) Write a balance equation showing nuclear fission of uranium $\left({}^{235}_{92}U\right)$ nucleus.

(ii) In a nuclear reactor, what is the function of

(a) cadmium rods

(b) graphite rods.

ISC-2010

251. Explain the release of energy in nuclear fission and fusion on the basis of binding energy per nucleon curve.

CBSE-2023

252. (a) Differentiate between nuclear fission and nuclear fusion.

(b) Deuterium undergoes fusion as per the reaction :

$${}^{2}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}He + {}^{1}_{0}n + 3.27\,MeV$$

Find the duration for which an electric bulb of 500 W can be kept glowing by the fusion of 100 g of deuterium.

CBSE-2023, 2022

Meghalaya Board-2021

253. (a) Depict the variation of the potential energy of a pair of nucleons with the separation between them.

(b) Imagine the fission of a ${}^{56}_{26}Fe$ into two equal fragments of ${}^{28}_{13}Al$ nucleus. Is the fission energetically possible ? Justify your answer by working out Q value of the process.

Given: $m\left({}^{56}_{26}Fe\right) = 55.93494\,u, m\left({}^{28}_{13}Al\right) = 27.98191\,u.$

CBSE-2022

Manipur Board-2022

254. How is energy produced inside the Sun? Explain with the Proton-Proton cycle.

Assam Board-2016

255. (a) What are isotones ?

(b) $A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3$

The mass number and atomic number of A are 180 and 72 respectively. What are these number for A_3 ?

Meghalaya Board-2019

256. Complete the following nuclear equation:

$${}^{32}_{15}P \rightarrow {}^{32}_{16}S + ? + \bar{V}$$

Meghalaya Board-2015

257. Complete the following reactions and name the type of reaction:

(a) ${}_{92}U^{235} + {}_{0}n^{1} \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + ? + \text{Energy}$

(b) ${}_{1}H^{2} + {}_{1}H^{2} \rightarrow ? + {}_{0}n^{1} + \text{Energy}$

Meghalaya Board-2013

258. Draw the graph showing the variation of average binding energy per nucleon of a nucleus with its mass number. Explain nuclear fission and fusion on the basis of this graph.

Odisha Board-2020

Section-D (Long Answer)

259. What is a nuclear reactor? Explain the functions of :

(i) Moderator

(ii) Control rods and

(iii) Neutron reflectors.

Mention the uses of nuclear reactor (diagram not necessary)

Tamil Nadu Board-2016

260. Mention any two points of difference between the phenomena of 'nuclear fission' and 'nuclear fusion'. Explain using the graph for binding energy per nucleon $\frac{BE}{A}$ versus mass no. (A), how the release of energy is accounted for in two cases.

NIOS-2013

261. Energy generation in stars is due to nuclear fusion.

(a) How a nuclear fusion is occurred?

(b) The energy released in nuclear fission process with uranium is of the order of____

(c) Three types of radio active decay occur in nature. Briefly describe them.

(d) State the law of radio active decay.

Kerala Board-2014

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14. Semiconductors Material, Electronics Devices and Simple Circuits

I. Classification of Metals Conductors and Semiconductors

Section-A (Multiple Choice Questions)

1. Choose the correct option:
Electrical conductivity of semi conductor-
(a) decreases with rise in its temperature.
(b) increases with rise in its temperature.
(c) does not changes with temperature.
(d) first decreases and then increases with rise in temperature.

Punjab Board-2018

Ans. (b) :

2. In an N-type semiconductor, there are :
(a) Immobile positive ions
(b) Immobile negative ions
(c) Holes as majority carriers
(d) No minority carriers

Tamil Nadu Board-2015, 2016, 2018

Ans. (a) :

3. In a Colpitt's oscillator circuit:
(a) capacitive feedback is used
(b) tapped coil is used
(c) no tuned LC circuit is used
(d) no capacitor is used

Tamil Nadu Board-2017

Ans. (a) :

4. Avalanche breakdown is primarily dependent on the phenomenon of:
(a) collision (b) ionisation
(c) doping (d) recombination

Tamil Nadu Board-March, 2016

Ans. (a) :

5. The typical ionization energy of a donor in silicon is
(a) 10.0 ev (b) 1.0 ev
(c) 0.1 ev (d) 0.001 ev

Nagaland Board-2018

Ans. (c) :

6. In an n-type silicon, which of the following statement is true ?
(a) Electrons are majority carriers and trivalent atoms are the dopants.
(b) Electrons are majority carriers and pentavalent atom are the dopants.
(c) Holes are minority carriers and pentavalent atoms are the dopants.
(d) Holes are minority carriers and trivalent atoms are the dopants.

Nagaland Board-2020
Gujarat Board-March, 2020

Ans. (b) :

7. …….. as a whole, is electrically neutral and therefore contains equal amount of positive and negative charges.

Haryana Board-2022

Ans. : Atom

8. The number of charge carriers can be changed by 'doping' of a suitable impurity in pure semiconductors. Such semiconductors are known as …….. semiconductors.

Haryana Board-2022

Ans. : Extrinsic semiconductor

9. In a p-type semiconductor the minority charge carriers are:
(a) Electron (b) Hole
(c) Electron and Hole (d) None of these

Haryana Board-2022

Ans. (a) :

10. At absolute zero temperature, a crystal of pure germanium behaves as:
(a) a perfect conductor (b) a perfect insulator
(c) a semiconductor (d) None of these

Haryana Board-2022

Ans. (b) :

11. What type of semi-conductor is obtained by doping Arsenic with silicon?
(a) N (b) P
(c) Both (d) None

Haryana Board-2018

Ans. (a) :

12. What type of Semiconductor is obtained by doping Indium with Silicon?
(a) N (b) P
(c) Both (d) None

Haryana Board-2016

Ans. (b) :

13. The density of electron and holes in an intrinsic semiconductor is n_e and n_h respectively. Which of the following option are true?
(a) $n_e = n_h$ (b) $n_e > n_h$
(c) $n_e < n_h$ (d) $n_e >> n_h$

Gujarat Board- May, 2021

Ans. (a) :

Search On TG: @apna_pdf

14. When will the conductivity of a Ge semiconductor decreases?
(a) In making UV light incident
(b) On adding acceptor impurity
(c) On adding donor impurity
(d) On decreasing the temperature

Gujarat Board- May, 2021
Gujarat Board-March, 2019

Ans. (d) :

15. ———as a impurity, when added in Si or Ge P-type semiconductor is obtained.
(a) Antimony (b) Arsenic
(c) Phosphorus (d) Boron

Gujarat Board- March, 2020

Ans. (d) :

16. n-type semiconductor is formed when dopant atom is
(a) Monovalent (b) Bivalent
(c) Trivalent (d) Pentavalent

Jharkhand Board-2023
J&K Board-2019

Ans. (d) :

17. As temperature increases the resistance of a semiconductor
(a) increases (b) decreases
(c) remains constant (d) none of these

Jharkhand Board-2023

Ans. (b) :

18. If the forbidden energy gap in a substance is 1 eV, substance is a
(a) Conductor (b) Semiconductor
(c) Insulator (d) Superconductor

Jharkhand Board-2020

Ans. (b) :

19. In a semiconductor, the electrical conductivity is due to
(a) electrons only
(b) holes only
(c) electrons and holes both
(d) none of these

Jharkhand Board-2020

Ans. (c) :

20. When indium is doped to silicon as impurity, the resulting material is
(a) p-type semiconductor
(b) n type semiconductor
(c) p-type conductor
(d) n-type conductor

Jharkhand Board-2019

Ans. (a) :

21. In n-type semiconductor, the majority charge carriers are
(a) photons (b) electrons
(c) holes (d) protons

Jharkhand Board-2018

Ans. (b) :

22 The P- type semiconductor is:
(a) Positively charged
(b) negatively charged
(c) uncharged at 0K, but negatively charged at a high temperature
(d) uncharged

Odisha Board-2020
MP Board-2018

Ans. (d) :

23. Forbidden energy gap for Germanium semi conductor is-
(a) 1.1 eV (b) 1.9 eV
(c) 0.72 eV (d) 0.75 eV

MP Board-2023

Ans. (d) :

24. At 0K, Germanium behaves as……..
(a) a conductor
(b) an intrinsic semiconductor
(c) an insulator
(d) an extrinsic semiconductor

NIOS-2017

Ans. (c) :

25. (a) In a semiconductor, the energy gap between valence band and conduction band is nearly:
(a) 5 eV (b) 1 eV
(c) 15 eV (d) zero

UP Board-2022

Ans. (b) :

26. The energy required by an electron to jump the forbidden band in silicon at room temperature is about
(a) 0.01 eV **(b) 0.05 eV**
(c) 0.7 eV **(d) 1.1 eV**

CBSE-2023

Ans. (d) :

27. Assertion (A): The resistance of an intrinsic semiconductor decreases with increase in its temperature.
Reason (R): The number of conduction electrons as well as hole increase in an intrinsic semiconductor with rise in its temperature.

CBSE-2023

Ans. () :

28. At 0 K, the resistivity of an intrinsic semiconductor is :
(a) same as that at 0°C
(b) same as that at 300 K
(c) zero
(d) infinite

CBSE-2023

Ans. (d) :

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29. At a certain temperature in an intrinsic semiconductor, the electrons and holes concentration is 1.5×10^{16} m^{-3}. When it is doped with a trivalent dopant, hole concentration increases to $4{\cdot}5 \times 10^{22}$ m^{-3}. In the doped semiconductor, the concentration of electrons (n_e) will be :

(a) 3×10^{6} m^{-3} (b) 5×10^{7} m^{-3}
(c) 5×10^{9} m^{-3} (d) 6.75×10^{38} m^{-3}

CBSE-2023

Ans. (a) :

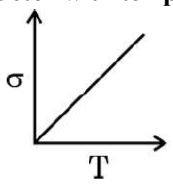
30. In an extrinsic semiconductor, the number density of holes is 4×10^{20} m^{-3}. If the number density of intrinsic carriers is 1.2×10^{15} m^{-3} . the number density of electrons in it is

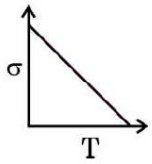
(a) 1.8×10^{9} m^{-3} (b) 2.4×10^{10} m^{-3}
(c) 3.6×10^{9} m^{-3} (d) 3.2×10^{10} m^{-3}

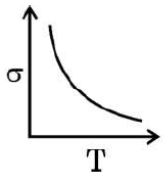
CBSE-2023

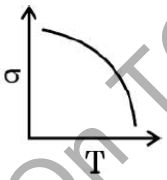
Ans. (c) :

31. Which one of the following is the correct representation of variation of conductivity of a conductor with temperature ?

(a) 

(b) 

(c) 

(d) 

CBSE-2023

Ans. (c) :

32. In the energy-band diagram of n-type Si, the gap between the bottom of the conduction band E_C and the donor energy level E_D is of the order of :

(a) 10 eV (b) 1 eV
(c) 0.1 eV (d) 0.01 eV

CBSE-2023

Ans. (d) :

33. When an intrinsic semiconductor is doped with a small amount of trivalent impurity, then :

(a) its resistance increases.
(b) it becomes a p-type semiconductor.
(c) there will be more free electrons than holes in the semiconductor.
(d) dopant atoms become donor atoms.

CBSE-2023

Ans. (b) :

34. In an n-type semiconductor, the donor energy level lies

(a) at the centre of the energy gap.
(b) just below the conduction band.
(c) just above the valance band.
(d) in the conduction band.

CBSE-2020

Ans. (b) :

35. When the temperature of an n-type semiconductor is increased, then the

(a) number of free electrons increase while that of the holes decreases.
(b) number of holes increases while that of the free electrons decreases.
(c) number of free electrons and holes remains unchanged.
(d) number of both the free electrons and the holes increase equally.

CBSE-2020

Ans. (d) :

36. A hole in a p-type semiconductor is :

(a) an excess electron
(b) a missing electron
(c) a missing atom
(d) a positive ion

J&K Board-2020

Ans. (b) :

37. n-type semiconductor is obtained by adding ---- ---- impurity to pure semiconductor.

(a) Trivalent (b) Tetravalent
(c) Pentavalent (d) All of these

J&K Board-2019

Ans. (c) :

38. The conductivity of an intrinsic semiconductor depends upon temperature only. (True/False)

J&K Board-2019

Ans. : True

39 When temperature increases, the conductivity of a semiconductor

(a) increases
(b) decreases
(c) remains same
(d) first increases and then decreases

Odisha Board-2022

Ans. (a) :

40. With the increase in temperature, the width of the forbidden gap will-

(a) decrease (b) increase
(c) remain same (d) becomes zero

Manipur Board-2022

Ans. (a) :

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41. The majority charge carriers in n-type semiconductors are–
(a) Proton (b) Electron
(c) Neutron (d) Holes
Uttarakhand Board-2020
Chhattisgarh Board-2018

Ans. (b) :

42. Current conduction in p-type semiconductor is:
(a) by atoms (b) by holes
(c) by electrons (d) by protons.
Uttarakhand Board-2023

Ans. (b) :

43. At 0 kelvin, the semiconductor behaves like
(a) a semiconductor
(b) a good conductor
(c) a bad conductor
(d) none of these
Bihar Board-2022

Ans. (c) :

44. With the increase of temperature the specific resistance of semi-conductor
(a) increases (b) decreases
(c) remains constant (d) becomes zero
Bihar Board-2022, 2019

Ans. (b) :

45. LASER action needs
(a) High temperature (b) Semiconductor
(c) High pressure (d) Number inversion
Bihar Board-2023

Ans. (d) :

46. The temperature coefficient of a semi-conductor is
(a) positive (b) negative
(c) zero (d) infinity
Bihar Board-2023

Ans. (b) :

47. A pure semiconductor is____.
(a) an extrinsic semiconductor
(b) an intrinsic semiconductor
(c) p-type semiconductor
(d) n-type semiconductor
Maharashtra Board-2018

Ans. (b) :

48. In a semiconductor, acceptor impurity is
(a) antimony (b) indium
(c) phosphorous (d) arsenic
Maharashtra Board-2015

Ans. (b) :

Section-B (Very Short Answer)

49. The potential barrier of a p-n junction tends to prevent the movement of _____ from n-side to p-side.
CBSE-2020

50. In an unbiased p-n junction diode, the n-side of the junction is at _____ potential as compared to that on the p-side of the junction.
CBSE-2020

51. The resistance and depletion layer in p-n junction diode decreases during forward bias.
J&K Board-2020

52. Draw the V-I characteristics for a P-N junction diode in forward-bias and reverse-bias condition.
Odisha Board-2022

53. Draw p-n junction with forward bias.
J&K Board-2016

54. Give the difference between conductor and semiconductor.
Meghalaya Board-2015

55. What are N-type semiconductors? How they are formed?
Haryana Board-2017

56. Why doping is done?
J&K Board-2016

57. A P-type semiconductor is positively charged (True/False)
J&K Board-2014, 2015

58. P-type semiconductor is electrically neutral. (True/False)
J&K Board-2022

59. On increasing the temperature, the resistivity of semiconductors is _____.
Rajasthan Board-2023

60. The —— are majority charge carriers and _____ are minority charge carriers in p-type semiconductor.
Rajasthan Board-2022, 2023

61. What do you mean by Doping ?
Tamil Nadu Board-2023, 2022

62. What is an intrinsic semi conductor? Give two examples.
Tamil Nadu Board-2017

63. What is a Hole? Which type of doping creates a hole?
J&K Board-2016

64. Why are semiconductors doped?
J&K Board-2023

65. What type of charge carriers are there in a p-type semiconductor?
J&K Board-2023

66. Write dependence of resistivity with temperature for semiconductors.
Rajasthan Board-2022

67. What are majority and minority charge carriers in a p-type semiconductor ?
Nagaland Board-2018

68. How N-type semiconductor is formed?
Haryana Board-2018

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69. Write a note on Mobility.
Gujarat Board- March, 2020

70. What is the effect of rise in temperature on the conductivity of a semiconductor?
Jharkhand Board-2023

71. Define semiconductor. Explain different types of semiconductor.
Jharkhand Board-2020

72. With increase in temperature of a semiconductor its conductivity .....
MP Board-2015

73. What will be the effect of increasing the temperature on the conductivity of pure semiconductor?
Maharashtra Board-2019
MP Board-2018, 2013
J&K Board-2017

74. Write the differences between N-type and P-type semiconductors.
MP Board-2022, 2014
Odisha Board-2022
Karnataka Board-July, 2019, 2018, 2016, 2014
Karnataka Board-March, 2017

75. How a intrinsic semiconductor is converted into a n-type semiconductor.
Chhattisgarh Board-2023

76. Which type of semiconductor will be formed, if trivalent impurity is added to pure semiconductor?
Chhattisgarh Board-2022
MP Board-2015

77. When antimony impurity is added to pure germanium, which type of semiconductor is obtained?
Chhattisgarh Board-2020

78. Draw a graph showing the variation of resistivity of a semiconductor with temperature.
NIOS-2021

79. Distinguish between intrinsic and extrinsic semiconductors on the basis of (i) electrical conductivity and (ii) the ratio between number of holes and number of conduction electrons.
NIOS-2016

80. Which impurity should be added in pure silicon to make it n-type silicon semi-conductor ? What is the valency of this doped element ?
UP Board-2017

81. To convert a pure semiconductor into n-type semiconductor, what type of impurity is added to it ?
ISC-2013

82. How can an n-type semiconductor be obtained from a pure crystal of germanium ?
ISC-2011

83. In which of the solids (semiconductors, conductors or insulators), do conduction band and valence band overlap ?
ISC-2009

84. What is meant by energy gap in solids ?
ISC-2007

85. Explain why the electrical conductivity of a pure semiconductor increases on heating ?
ISC-2005

86. What are energy bands in solids ?
ISC-2002

87. Draw energy band diagrams of conductors, semiconductors and insulators.
ISC-2007, 2000

88. Draw a plot of resistivity versus temperature for a typical semiconductor.
CBSE-2019

89. Draw energy band diagram for an n-type and p-type semiconductor at T > 0 K.
MP Board-2023
CBSE-2023
Karnataka Board-March-2020
Meghalaya Board-2017

90. Differentiate between intrinsic and extrinsic semiconductors.
CBSE-2023
Meghalaya Board-2021
UP Board-2019

91. Draw the energy band diagrams (at T > 0 K) for n-type and p-type semiconductors. Using diagram, explain why in n-type semiconductor the conduction band has most electrons from the donor impurities.
CBSE-2022

92. C and Si both have the same lattice structure, but C is an insulator while Si is a semiconductor. Justify.
CBSE-2022

93. (a) In n-type semiconductor, explain how the crystal is electrically neutral although electrons are the majority carriers in it.
(b) Write the conditions under which two light sources are said to be coherent.
CBSE-2022

94. A p-type semiconductor is electrically neutral although it has holes as the majority carriers. Justify.
CBSE-2022

95. What is meant by energy band gap in a solid ? Draw the energy band diagrams for a conductor, an insulator and a semiconductor.
CBSE-2022

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96. Name the extrinsic semiconductors formed when a pure germanium is doped with (i) a trivalent and (ii) pentavalent impurity. Draw the energy band diagrams extrinsic semiconductors so formed.

CBSE-2022

97. Draw the energy band diagrams for conductors, semiconductors band insulators. Which and determines the electrical conductivity of a solid ? How is the electrical conductivity of a semiconductor affected with rise in its temperature ? Explain.

CBSE-2022

98. Explain the formation of the barrier potential in a p-n junction.

CBSE-2022

99. What is meant by doping of an intrinsic semiconductor ? Name the two types of atoms used for doping of Ge/Si.

CBSE-2022

100. Distinguish between intrinsic and extrinsic semiconductors. Although in an extrinsic semiconductor $n_e \neq n_h$, yet it is electrically neutral. Why ?

CBSE-2022

101. Draw energy band diagrams of n-type and p-type semiconductors at temperature T > 0K, depicting the donor and acceptor energy levels. Mention the significance of these levels.

CBSE-2022

102. The _____, a property of materials C, Si and Ge depends upon the energy gap between their conduction and valence bands.

CBSE-2020

103. (a) Explain energy bands in a crystalline silicon semiconductor.

(b) How is an intrinsic semiconductor converted into
(i) p-type, and
(ii) n-type
extrinsic semiconductor ? Draw their energy band diagrams showing impurity level.

CBSE-2020

104. Graphically represent the variation of resistivity of a semiconductor with absolute temperature.

Karnataka Board-March, 2020

105. What are intrinsic semiconductors? Name the element used as a do pant to obtain p-type semiconductor.

Karnataka Board-July, 2015

105. What is the impact of temperature on the resistivity of metals and semiconductors.

Uttarakhand Board-2022

106. Give the name of majority charge carriers in n-type and p-type semiconductors.

Uttarakhand Board-2022

107. Write the name of majority and minority charge carriers in p-type semiconductors.

Uttarakhand Board-2019

108. What do you mean by forbidden region in semiconductor ?

Bihar Board-2021

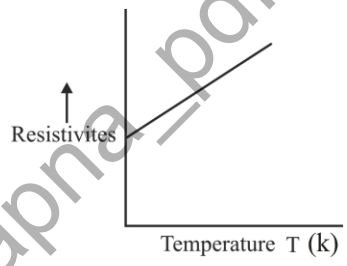
109. What is energy band gap of a semiconductor? What range of energy band gap semiconductors is suitable for using in solar cells?

Assam Board-2013

110. Discuss conductor and insulator in terms of energy gap.

Assam Board-2023

111.



(a) From the above figures which one corresponds to a typical semiconductor.

(b) Dimension of temperature coefficient α is _____

Kerala Board-2014

Section-C (Short Answer)

112. Explain the formation of energy bands in solids.

J&K Board-2014

113. Distinguish between p-type and n-type extrinsic semiconductor.

J&K Board-2022

114. Distinguish between an intrinsic semiconductor and p-type semiconductor. Why is p-type semiconductor crystal neutral?

J&K Board-2023
NIOS-2012

115. The number of silicon atoms per m^3 is 5×10^{28}. This is doped simultaneously with 5×10^{22} atoms per m^3 of Arsenic and 5×10^{20} per m^3 of atoms of Indium. Calculate the number of electrons and holes. Given that $n_i = 1.5\times10^{16}m^{-3}$. Is the material n- type or p-type?

Gujarat Board- August, 2020

116. What are energy bands in solids ? How are these formed? How do we classify solids as conductors and semiconductors on the basis of energy band diagram?

NIOS-2017

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117. Draw a labelled energy band diagram for a solid which is an insulator. What is the main difference between this diagram and that of a semiconductor ?

ISC-2011

118. (a) Obtain the expression for the current flowing through a conductor having number density of the electrons n, area of cross-section A in terms of the drift velocity v_d.

(b) How does the resistivity of a semiconductor change with rise of temperature? Explain.

CBSE-2019

119. Draw the energy band diagram of (i) n-type and (ii) p-type semiconductors at temperature T > 0 K.

In the case of n-type Si-semiconductor, the donor energy level is slightly below the bottom of conduction band whereas in p-type semiconductor, the accepter energy level is slightly above the top of valence band. Explain, giving examples, what role do these energy levels play in conduction and valence bands.

CBSE-2019

120. Show, on a plot, variation of resistivity of (i) a conductor, and (ii) a typical semiconductor as a function of temperature.

Using the expression for the resistivity in terms of number density and relaxation time between the collisions, explain how resistivity in the case of a conductor increases while it decreases in a semiconductor, with the rise of temperature.

CBSE-2019

121. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.

CBSE-2023

122. Distinguish between conductors, insulators and semiconductors on the basis of energy band.

Manipur Board-2022
UP Board-2021
Karnataka Board-March, 2015, 2017
Karnataka Board-July, 2014
Karnataka Board-March, 2014
J&K Board-2011

123. What are optoelectronic devices? Name any two optoelectronic device.

Karnataka Board-July, 2020

124. With the help of graphs, show, how resistivety changes with temperature in the cases of (i) Copper, (ii) Nichrome and (iii) Semiconductor.

Assam Board-2017

124. A semiconductor has equal electron and hole concentration 6×10^8 m^{-3}. On doping with a certain impurity, electron concentration increases to 9×10^{12} m^{-3}. Calculate the new hole concentration. Also identify the new semiconductor.

Meghalaya Board-2019

125. What is meant by the term 'doping'? Mention the various methods of doping and explain them in brief.

Meghalaya Board-2021

Section-D (Case-Based Questions)

126. Two crystals C_1 and C_2, made of pure silicon, are doped with arsenic and aluminum respectively.

(a) Identify the extrinsic semiconductors so formed.

(b) Why is doping of intrinsic semiconductors necessary?

CBSE-2022

127. 100 mg mass of nichrome metal is drawn into a wire of area of cross-section 0.05 mm^2. Calculate the resistance of this wire. Given density of nichrome 8.4×10^3 kgm^{-3} and resistivity of the material as 1.2×10^{-6} Ωm.

Karnataka Board-July, 2018

Section-E (Long Answer)

128. What is intrinsic semiconductor ? Explain the process of p-n junction formation with necessary diagram.

Draw the symbol of the following diodes

(i) Zener diode

(ii) P-n junction diode

Rajasthan Board-2023

129. Carbon and silicon have the same lattice structure. Then why is carbon an insulator but silicon a semiconductor ?

CBSE-2023

130. A germanium crystal is doped with antimony. With the help of energy-band diagram, explain how the conductivity of the doped crystal is affected.

II. Semiconductor Diode, p-n Junction and Its Application

Section-A (Multiple Choice Questions)

131. In a semiconductor, acceptor impurity is

(a) antimony (b) indium
(c) phosphorous (d) arsenic

Maharashtra Board-2015

Ans. (b) :

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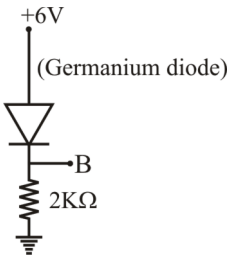
132. In the forward bias characteristic curve, a diode appears as :
(a) a high resistance (b) a capacitor
(c) ab OFF switch (d) an ON switch

Tamil Nadu Board-September, 2016
Tamil Nadu Board-2018, 2011

Ans. (d) :

133.



The Voltage at B in the figure is:
(a) 5.3V (b) 5.7V
(c) 6.3V (d) 6V

Tamil Nadu Board-March, 2016

Ans. (b) :

134. The colour of light emitted by an LED depends on
(a) its reverse bias
(b) the amount of forward current
(c) its forward bias
(d) type of semiconductor material.

Tamil Nadu Board-2011

Ans. (d) :

135. Type of material which emits white light in LED:
(a) GalnN
(b) SiC
(c) ALGaP
(d) GaAsP

Tamil Nadu Board-2023

Ans. (a) :

136. For detecting the light,
(a) The LED has to be connected in forward bias mode
(b) The photodiode has to be reverse biased
(c) The photodiode has to be forward biased
(d) The LED has to be connected in a reverse bias mode

Gujarat Board- May, 2021

Ans. (b) :

137. IN order to operate _____ type of semiconductor, we have to apply the forward bias.
(a) varactor diode
(b) Zener diode
(c) photo diode
(d) light emitting diode (LED)

Gujarat Board- May, 2021

Ans. (d) :

138. When a forward bias applied to a p-n junction, it.
(a) raises the potential barrier
(b) reduce the majority currier current to zero
(c) lowers the potential barrier
(d) none of the above

Gujarat Board- March, 2020
Gujarat Board- August, 2020

Ans. (c) :

139. If n_e = number of free electrons, n_h = number of holes then for pure semi conductors;
(a) $n_e = n_h$ (b) $n_h > n_e$
(c) $n_e > n_h$ (d) $n_e = n_h^2$

Gujarat Board-March, 2022

Ans. (a) :

140. When p-n junction is kept in forward bias, ____.
(a) Barrier potential increases
(b) Current due to majority charge carrier decreases
(c) Barrier potential decreases
(d) None of the given choices

Gujarat Board-March, 2022

Ans. (c) :

141. _____eV energy is required for electron to jump the forbidden gap at room temperature in the pure Si.
(a) 0.11 (b) 1.1
(c) 2.1 (d) 0.21

Gujarat Board- July, 2022

Ans. (b) :

142. _____ is used as a voltage regulator.
(a) Photocell
(b) Light Emitting Diode
(c) Zener diode
(d) Solar cell

Gujarat Board- July, 2022

Ans. (c) :

143. Photodiode functions in
(a) Forward biased condition
(b) Reverse biased condition
(c) Both forward and reversed biased conditions
(d) None of these

Jharkhand Board-2019

Ans. (b) :

144. In p-n junction diodes the depletion layer has high resistance because it contains :
(a) no charge carriers
(b) large number of charge carrier
(c) only electrons as charge carriers
(d) only holes as charge carriers

NIOS-2022

Ans. (a) :

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145. The current gain of a transistor in common base configuration is 0.95. Its current gain in common emitter configuration would be :

(a) 0.95 (b) 95
(c) 19 (d) 1/19

NIOS-2017

Ans. (c) :

146. Which one of the following semiconductor devices does not need any reverse bias for its operation?

(a) Zener diode (b) LED
(c) Photodiode (d) Solar cell

NIOS-2017

Ans. (d) :

147. a. In depletion layer of p-n junction diode, there are

(a) only electrons
(b) only holes
(c) both electrons and holes
(d) neither electrons nor holes

MP Board-2019
UP Board-2019, 2017

Ans. (c) :

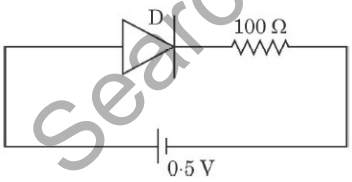
148. During the formation of a p-n junction:

(a) diffusion current keeps increasing.
(b) drift current remains constant.
(c) both the diffusion current and drift current remain constant.
(d) diffusion current remains almost constant but drift current increases till both currents become equal.

CBSE-2023

Ans. (d) :

149. The threshold voltage for a p-n junction diode used in the circuit is 0.7 V. The type of biasing and current in the circuit are :



(a) Forward biasing, 0 A
(b) Reverse biasing, 0 A
(c) Forward biasing, 5 mA
(d) Reverse biasing, 2 mA

CBSE-2023

Ans. (a) :

150. For the forward biasing of a p-n junction diode, which of the following statements is not correct ?

(a) The potential barrier decreases.
(b) Minority carrier injection occurs.
(c) Width of depletion layer increases.
(d) Forward current is due to the diffusion of both holes and electrons.

CBSE-2023

Ans. (c) :

151. If a p-n junction diode is reverse biased,

(a) the potential barrier is lowered.
(b) the potential barrier remains unaffected.
(c) the potential barrier is raised.
(d) the current is mainly due to majority carriers.

CBSE-2023

Ans. (c) :

152. The formation of depletion region in a p-n junction diode is due to

(a) movement of dopant atoms
(b) diffusion of both electrons and holes
(c) drift of electrons only
(d) drift of holes only

CBSE-2023

Ans. (b) :

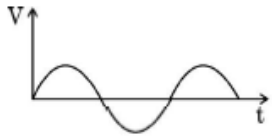
153. A semiconductor device is connected in series with a battery, an ammeter and a resistor. A current flows in the circuit. If the polarity of the battery is reversed, the current in the circuit almost becomes zero. The device is a/an

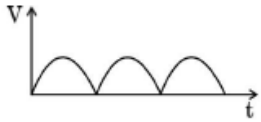
(a) intrinsic semiconductor
(b) p-type semiconductor
(c) n-type semiconductor
(d) p-n junction diode

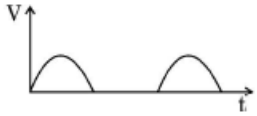
CBSE-2023

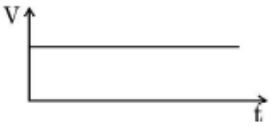
Ans. (d) :

154. An ac source of voltage is connected in series with a p-n junction diode and a load resistor. The correct option for output voltage across load resistance will be :

(a)


(b)


(c)


(d)


CBSE-2023

Ans. (a) :

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155. The wavelength and intensity of light emitted by a LED depend upon

(a) Forward bias and energy gap of the semiconductor
(b) Energy gap of the semiconductor and reverse bias
(c) Energy gap only
(d) Forward bias only

CBSE-2020

Ans. (a) :

156. Photo diodes are used to detect

(a) Radio waves (b) Gamma rays
(c) IR rays (d) Optical signals

CBSE-2020

Ans. (d) :

157. At equilibrium, in a p-n junction diode the net current is

(a) due to diffusion of majority charge carriers.
(b) due to drift of minority charge carriers.
(c) zero as diffusion and drift currents are equal and opposite.
(d) zero as no charge carriers cross the junction.

CBSE-2020

Ans. (c) :

158. **is the symbol of**

(a) diode (b) n-type
(c) p-type (d) transistor

Bihar Board-2023

Ans. (a) :

159. Diode is used as

(a) Amplifier (b) Oscillator
(c) Modulator (d) Rectifier

Bihar Board-2023

Ans. (d) :

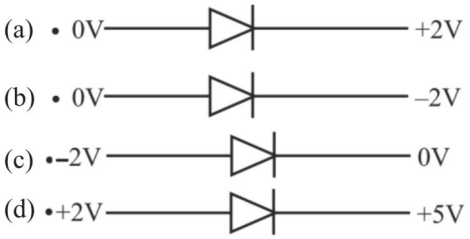
160. The LED emits visible light when its_____.

(a) junction is reverse biased.
(b) depletion region widens
(c) holes and electrons recombine
(d) junction becomes hot

Maharashtra Board-2023

Ans. () :

161. In which one of the given figures, is the function diode forward biased?



Goa Board-2023

Ans. (b) :

Section-B (Very Short Answer)

162. What is Light Emitting Diode (LED)? Give its symbol.

Tamil Nadu Board-September, 2016

163. What is light emitting diode? Give any one of its uses.

Tamil Nadu Board-2015

(OR)

What is depletion region in a P-n junction?

J&K Board-2012

164. How P-type semi-conductor is formed?

Haryana Board-2016

165. Explain the depletion layer and depletion barrier of a PN junction diode.

Gujarat Board- May, 2021

166. What is LED ? Mention two of its applications.

Jharkhand Board-2018

167. What is light emitting diode (LED)? Explain its working principle and state factors on which the colour of light emitted by it depends.

MP Board-2015

168. How should a junction diode be connected to the battery to keep it facing forward?

Chhattisgarh Board-2021

169. Explain the formation of depletion region in a p–n Junction diode with the help of a suitable diagram.

NIOS-2012

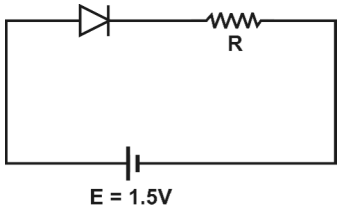
170. What are intrinsic semiconductors? Explain how a semiconductor can be converted into an n-type semiconductor.

NIOS-2013

171. Describe in brief the formation of depletion region in a p-n junction diode with a suitable diagram.

NIOS-2014

172. A diode used in a circuit has a constant voltage drop of 0.5V at all currents and a maximum power rating of 100 mW. Find the value of the resistance R connected in series with the diode for obtaining maximum current.



NIOS-2015

173. In a junction diode how much is junction current at equilibrium without any applied external voltage?

NIOS-2015

Search On TG: @apna_pdf

174. Which basic mechanism/principal is involved in the working of a photodiode?

NIOS-2016

175. What is meant by directional characteristics of a p-n junction? Give its one application based on this characteristic.

NIOS-2017

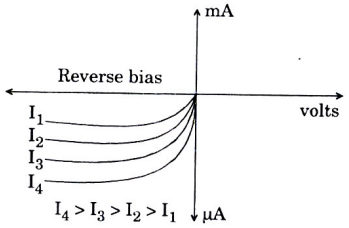
176. Why is depletion region named so in a semiconductor diode? What is total charge of depletion region in a diode in forward biasing?

NIOS-2019

177. When a p-n junction diode is forward biased, how will its barrier potential be affected?

CBSE-2019

178. Identify the semiconductor diode whose V-I characteristics are as shown.



CBSE-2019

179. Draw a circuit diagram of a p-n junction diode in (a) forward biasing, and (b) reverse biasing. Draw the V I characteristics for each case

CBSE-2023

180. Answer the following giving reasons
(i) A p-n junction diode is damaged by a strong current
(ii) Impurities are added in intrinsic semiconductors

CBSE-2023

181. Draw the circuit arrangement for studying the V– I characteristics of a p-n junction diode in forward bias and reverse bias. Show the plot of V– I characteristic of a silicon diode.

CBSE-2023

182. Briefly explain how the diffusion and drift currents contribute to the formation of potential barrier in a p-n junction diode.

CBSE-2023

183. Explain how the barrier potential is formed in a p-n junction. How is it affected in
(a) forward bias, and
(b) reverse bias ?

CBSE-2022

184. (i) Draw V-I characteristics of a p-n Junction diode.
(ii) Differentiate between the threshold voltage and the breakdown voltage for a diode.
(iii) Write the property of a junction diode which makes it suitable for rectification of ac voltages.

CBSE-2022

185. Why a photo – diode is operated in reverse bias whereas current in the forward bias is much larger than that in the reverse bias ? Explain Mention its two uses.

CBSE-2022

186. Define barrier potential. Why does the thickness of the depletion layer in a p-n junction diode vary with increase in reverse bias ?

CBSE-2022

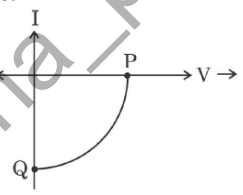
187. Explain the formation of the barrier potential in a p-n junction.

CBSE-2022

188. (a) Draw the circuit diagram of an illuminated photodiode and its I-V characteristics.
(b) How can a photodiode be used to measure the light intensity ?

CBSE-2022

189. The V I characteristics of a solar cell is shown in the figure.



(a) What do the points P and Q represent ?
(b) Give the circuit diagram for a solar cell.

CBSE-2019, 2022

190. Briefly explain the working of a light emitting diode. Mention its two uses.

CBSE-2022

191. How is an emf generated by a solar cell due to the three basic processes involved ? Explain.

CBSE-2022

192. Explain the formation of depletion region in a p-n junction.

CBSE-2022

193. State the working principle of an LED. Write any two important advantages and two disadvantages of LED.

CBSE-2022

194. Write the characteristics of a p-n junction which make it suitable for rectification.

CBSE-2022

195. The ability of a junction diode to _____an alternating voltage, is based on the fact that it allows current to pass only when it is forward biased.

CBSE-2020

196. (a) Explain the formation of energy bands in crystalline solids.
(b) Draw the energy band diagrams of (i) a metal and (ii) a semiconductor.

CBSE-2020

Search On TG: @apna_pdf

197. (a) Why is a photo diode operated under reverse bias condition?
(b) Draw V-I characteristic curves of photo diode for incident light of intensities I_1 and $I_2(I_1 > I_2)$.

OR

(c) State the level of doping and biasing condition used in light emitting diode (LED).
(d) Write any two advantages of LED over the conventional low power lamps.

CBSE-2020

198. Briefly explain how a potential barrier is set up across a p-n junction as a result of diffusion and drift of the charge carriers.

CBSE-2020

199. Can a slab of p-type semi-conductor be physically joined to another n-type semiconductor slab to form p-n junction? Justify your answer.

OR

In a p-n junction diode the forward bias resistance is low as compared to the reverse bias resistance. Give reason.

CBSE-2020

200. What is the function of a solar cell? Briefly explain its working and draw its I-V characteristic curve.

CBSE-2020

201. Draw V-I characteristics of a p-n junction diode. Explain, why the current under reverse bias is almost independent of the applied voltage up to the critical voltage.

CBSE-2020

202. State the working principle of an LED . Write any two important advantages and two disadvantages of LED.

CBSE-2020

203. Explain the formation of depletion layer and barrier potential in p-n junction diode.

CBSE-2020

204. Explain the terms 'depletion layer' and potential barrier' in a p-n junction diode. How are the (a) width of depletion layer, and (b) value of potential barrier effected when the p-n junction is forward biased?

CBSE-2020

205. Why cannot we use Si and Ge in fabrication of visible LEDs?

CBSE-2020

206. How does an increase in doping concentration affect the width of depletion layer of a p-n junction diode?

CBSE-2020

207. With the help of the circuit diagram, explain the working of a silicon p-n junction diode in forward biasing and draw its I – V characteristics.

CBSE-2020

208. What is 'depletion region' in a semi conductor diode?

Karnataka Board-July, 2018

209. Name the majority and minority charge carriers in n - type semiconductor?

Uttarakhand Board-2023

210. The space-charge region on both sides of a p-n junction is known as
(i) cut-off region
(ii) active region
(iii) depletion region

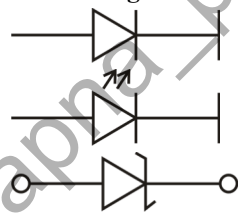
Assam Board-2023

211. Give a comparative discussion on majority and minority carriers in n-type and p-type semiconductors. 2

Assam Board-2017

212. Diodes are one of the building elements of electronic circuits. Some type of diodes are shown in the figure.

(i)
(ii)
(iii)



(a) Identify rectifier diode from the figure.
(b) Draw the circuit diagram of a forward biased rectifier diode by using a battery.

Kerala Board-2020

213. What is meant by the term 'doping' mention the various methods of doping.

Meghalaya Board-2023

Section-C (Short Answer)

214. Why does the thickness of depletion layer of pn-junction increases in reverse biasing? Draw the circuit diagram of reverse biasing.

Punjab Board-2018

215. How is junction diode formed ? Discuss the working of a function diode as full wave rectifier.

J&K Board-2023

216. What is a rectifier? Explain the working of P-N diode as full wave rectifier.

Haryana Board-2018

217. Draw circuit diagram for studying V → I characteristics of a p - n junction diode in
(a) Forward bias and
(b) Reverse bias
Also draw a typical V → I characteristics of a silicon diode.

Gujarat Board- July, 2022

218. At 300 K temperature the saturated current in Germanium diode is 10 μA. Find the:

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(i) forward voltage when diode current is 100 mA.
(ii) Diode current at backward biased boltage 0.01 volt.

MP Board-2013

219. What is the principle of semiconductor Laser? Write its any two advantages and disadvantages.

MP Board-2018

220. What is P-N junction diode? How does diode used as a forward bias? Explain.

MP Board-2022

221. What is light-emitting diode (LED)? Write two advantages of using LED over conventional low power traditional lamps.

Chhattisgarh Board-2021
Bihar Board-2021

222. Draw the V-I characteristic curve of a solar cell. What should be the order of bond gap and photo-absorption coefficient of the semi-conducting material used for the fabrication of solar cell?

Chhattisgarh Board-2019

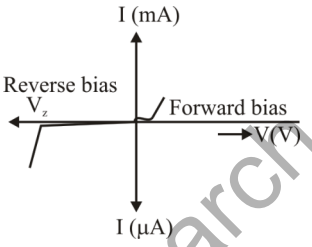
223. Explain the principle and working of a transistor as an oscillator. Draw a schematic diagram showing its various parts.

NIOS-2012

224. Draw the circuit diagram of p-n junction diode in forward bias. Plot the characteristic curve and explain it.

UP Board-2019

225. The figure shows the V-I characteristic of a semiconductor diode designed to operate under reverse bias.



(a) Identify the semiconductor diode used.
(b) Draw the circuit diagram to obtain the given characteristics of this device.
(c) Briefly explain one use of this device.

CBSE-2019

226. A particle of charge q and mass m is moving with velocity $\vec{v}$ in the positive x-direction.
(a) It is subjected to a uniform magnetic field B directed along negative z- direction. Explain briefly the trajectory it would describe.
(b) When the particle is subjected simultaneously to both the magnetic and electric fields directed along the z-axis and y-axis respectively, obtain the condition when the particle will go undeflected.

CBSE-2019

227. (a) Explain how a potential barrier is developed in a p-n junction diode.
(b) Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode in reverse bias. Plot the V-I characteristics in this case.

CBSE-2019

228. (a) Three photo diodes D_1, D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2eV and 3eV respectively. Which of them will not be able to detect light of wavelength 600 nm?
(b) Why photodiodes are required to operate in reverse bias? Explain

CBSE-2019

229. Draw the circuit arrangement for studying V-I characteristics of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Draw the typical V-I characteristics of a silicon diode. Describe briefly the following terms: (i) minority carrier injection in forward biasing and (ii) breakdown voltage in reverse biasing.

CBSE-2023

230. Name two important processes involved in the formation of a p-n junction diode. With the help of a circuit diagram, explain the working of junction diode as a full wave rectifier. Draw its input and output waveforms. State the characteristic property of a junction diode that makes it suitable for rectification.

CBSE-2023

231. (a) Explain the formation of a p-n junction.
(b) Can we take one slab of p-type semiconductor and physically join it to another n-type semiconductor to get a p-n junction ? Explain.

CBSE-2022

232. Draw V-I characteristics of a p-n junction diode. Answer the following giving reasons :
(a) Why is the reverse bias current almost independent of applied voltage up to breakdown voltage ?
(b) Why does the reverse current show a sudden increase at breakdown voltage ?

CBSE-2022

233. Answer the following, giving reason :
(a) The resistance of a p-n junction is low when it is forward biased and is high when it is reversed biased.
(b) Doping of intrinsic semiconductors is a necessity for making electronic devices.
(c) Photodiodes are operated in reverse bias.

CBSE-2022

234. Explain the formation of potential barrier and depletion region in a p-n junction diode. What is effect of applying forward bias on the width of depletion region?

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OR

What is photo diode? Briefly explain its working and draw its V-I characteristics.

CBSE-2020

235. What is a solar cell ? Draw its V-I characteristics. Explain the three processes involved in its working.

CBSE-2020

236. (a) How are energy bands formed in a crystalline solid?

(b) Draw the energy band diagrams for p-type and n-type semiconductors. Depict the donor/acceptor energy levels in these diagrams and write their significance.

237. (a) Why is an intrinsic semiconductor deliberately converted into an extrinsic semiconductor by adding impurity atoms?

(b) Explain briefly the two processes that occur in p-n junction region to create a potential barrier.

CBSE-2020

238. What is the function of a solar cell? Briefly explain its working and draw its I-V characterisitic curve.

CBSE-2020

239. Draw the circuit diagram of a full-wave rectifier using two p-n junction diodes. Explain its working and draw its input and output waveforms.

CBSE-2020

240. What is a junction diode? Draw the circuit diagram for it in forward- biased condition.

Odisha Board-2023

241. What is rectification? Explain the working of a p-n junction diode as a half wave rectifier. Draw the input and output wave forms.

Karnataka Board-March, 2020

242. Explain 'Conduction band' 'Valance band' and 'Energy gap', in semiconductors.

Karnataka Board-March, 2019

243. Give any three differences between n-type and p-type semiconductors.

Karnataka Board-March, 2017

Karnataka Board-July, 2014, 2016

244. Drawing experimental circuit arrangment for p-n junction diode in forward and reverse biased condition, draw the V-I Characteristics curves in forward and reverse biased condition.

Uttarakhand Board-2020

245. What is dark current ? Explain the working principle of a photodiode. Give two important uses of photodiodes.

Meghalaya Board-2021

246. Define the terms 'potential barrier' and depletion region' for a p-n junction diode. How does the thickness of depletion region change when p-n junction is reverse biased?

Meghalaya Board-2017

247. (a) What are intrinsic semiconductors? Name the types of extrinsic semiconductor obtained when germanium is doped with (i) arsenic and (ii) gallium.

(b) Draw the I-V characteristics of a p-n junction diode in forward and reverse bias.

Meghalaya Board-2023, 2014

Section-D (Long Answer)

248. What is meant by forward bias and reverse bias of p-n junction diode? Draw an experimental electric circuit diagram to study the V-I characteristics curves for p-n junction diode and explain the following in brief:

(i) Threshold or cut in voltage

(ii) Breakdown voltage

Rajasthan Board-2022

249. Explain the use of P-N junction diode as full wave rectifier on the basis of the following points.

(i) Labelled circuit diagram

(ii) Working method

(iii) Graph between input and output potential with variation of time.

MP Board-2014

250. Explain flow of current in P-N junction diode as forward biasing.

Meghalaya Board-2018

MP Board-2017

251. Define N and P-type semiconductors. Explain the working of P-N junction diode with circuit diagram in forward bias and reverse bias.

MP Board-2021, 2019

252. (a) Classify solids as conductors, semiconductors and insulators, on the basis of energy bands. Draw one diagram each for their energy bands.

(b) Write down main two differences between intrinsic and extrinsic semiconductors.

NIOS-2021

253. (a) With the help of a circuit diagram explain how a transistor can be used as an amplifier in common-emitter configuration.

(b) Why CE configuration is preferred over other configuration for transistor amplifier?

(c) In a transistor, 50μA base current is required to change the collector current by 1 mA. Calculate current gain β.

NIOS-2018

254. Why depletion layer is formed in a p-n junction? Explain with the help of suitable diagram. Write the effect on the width of depletion layer of junction is in (i) forward bias and (ii) reverse bias.

UP Board-2021

Search On TG: @apna_pdf

255. What is meant by forward bias and reverse bias for p-n junction diode? How is it used as a full - wave rectifier? Explain with circuit diagram.

UP Board-2022

256. What is LED? Explain its principle, construction and workings.

UP Board-2023

257. Draw V-I characteristics of a p-n junction diode. Explain how these characteristics make a diode suitable for rectification.

CBSE-2023

258. (ii) Briefly explain the two processes involved in the formation of a p-n junction.

CBSE-2023

269. (iii) What will the effect of (1) forward biasing, and (2) reverse biasing be on the width of depletion layer in a p-n junction diode ?

CBSE-2023

260. What is rectification? With relevant circuit diagram and waveforms explain the working of P-N junction diode as a full-wave rectifier.

Karnataka Board-March, 2016

261. Describe with suitable block diagrams, action of p-n-junction diode under forward and reverse bias conditions. Also draw I-V characteristics.

Karnataka Board-July, 2018

262. Explain the working of p-n junction diode as a full wave rectifier with circuit diagram. Give input is output waveforms.

Karnataka Board-March, 2016, 2017
Karnataka Board-July, 2014, 2015

263. What is the meaning of forward bias and reverse bias for a p-n junction diode? Draw necessary circuit diagram also.

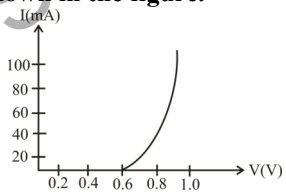
Uttarakhand Board-2022

264. Explain the working of P-N junction diode. Draw the circuit of full wave rectifier and explain its working.

Bihar Board-2023

265. A graph showing the variation of current (I) flowing through a p-n junction with the voltage (V) applied across it is called the V-I characteristic of a p-n junction.

(a) V – I Characteristic of a forward biased diode is shown in the figure.



Write any two important features of the graph.

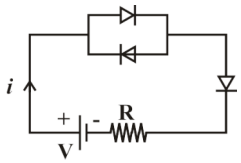
Kerala Board-2016

266. With the help of labelled circuit diagram, explain the working of a transistor as an amplifier using n-p-n transistor in CE configuration.

Meghalaya Board-2019

267. (a) Discuss the working of a photodiode. Why a photodiode is operated in reverse bias mode?

(b) Find the current *i* in the circuit given below:



Given, forward resistance of the diode is r_f = 1 Ω, R = 2 Ω and V = 10 volts.

Meghalaya Board-2018

268. Draw the I-V characteristics of a p–n junction diode in forward and reverse bias.

Meghalaya Board-2013

269. What are semiconductors? Discuss the formation of depletion layer and potential barrier in an unbiased p–n junction diode.

Meghalaya Board-2013

III. Special Diodes, and Zener Diode

270. What is Zener diode? How is it used as a voltage regulator?

Maharashtra Board-2018

Section-A (Multiple Choice Questions)

271. Zener diode functions in

(a) Forward biased condition
(b) reverse biased condition
(c) both forward and reverse biased condition
(d) none of these

Jharkhand Board-2023

Ans. (b) :

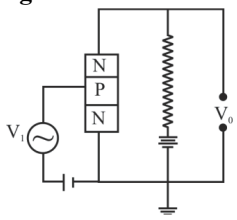
272. Zener-diode is used in

(a) Amplification
(b) Rectification
(c) Oscillator in producing oscillations
(d) Voltage regulation

MP Board-2015

Ans. (d) :

273. N-P-N transistor is arranged as in the following figure. This circuit is of



(a) common-base amplifier
(b) common-emitter amplifier
(c) common-collector amplifier
(d) none of these

UP Board-2023

Ans. (b) :

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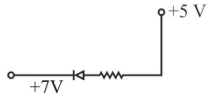
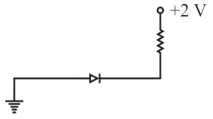
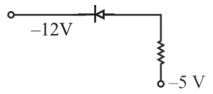
274. A zener diode has
(a) heavily doped p-side and lightly doped n-side.
(b) heavily doped n-side and lightly doped p-side.
(c) heavily doped n-side as well as p-side.
(d) lightly doped n-side as well as p-side.

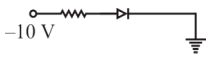
Ans. (c) :

275. In the following diagrams, which diode is forward biased?

(a) 

(b) 

(c) 

(d) 

Meghalaya Board-2015

Ans. (b) :

Section-B (Very Short Answer)

276. What is a photodiode?
Meghalaya Board-2013

277. Draw the circuit symbol of p-n-p transistor.
Karnataka Board-March, 2016

278. Draw the circuit diagram of a voltage regulator using zener diode.
Tamil Nadu Board-March, 2016

279. Describe the action of zener diode as a voltage regulator.
Tamil Nadu Board-2015

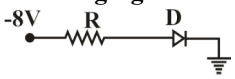
280. Draw difference amplifier circuit using Op-Amp.
Tamil Nadu Board-2011

281. Write the working of a voltage regulator made by using a Zener diode.
Rajasthan Board-2022

282. Differentiate between P- type and N- type Semiconductor (any four).
Gujarat Board-2023

283. As a voltage regulator ……. diode is used.
MP Board-2020

284. State the nature of biasing of diode in the following figure:



UP Board-2021

285. Draw the I-V characteristics of a Zener diode.
CBSE-2019

286. How is the width of depletion layer of a p-n junction diode affected when it is (i) forward biased, and (ii) reverse biased ? Justify your answers.
CBSE-2023

287. Give reasons for the following facts :
(a) The zener diode is fabricated using heavily doped p-side and n-side of the junction.
(b) A photodiode used as a detector of optical signals, is operated under reverse bias.
CBSE-2020

288. What is photodiode and solar cell ?
Manipur Board-2022

289. Why does zener diode work in reverse bias?
Manipur Board-2022

290. What is photo diode? Mention its one use.
Karnataka Board-March, 2015

291. In which bias can a zener diode be used as voltage regulator?
AP Board-2020

292. Compare the working principle of a LED and a photodiode.
Assam Board-2017

293. What is a Zener diode? How is it biased in normal operation?
Assam Board-2017
ISC-2010, 2012, 2016

294. Why is a photodiode preferably use in the reverse bias condition for measuring light intensity?
Assam Board-2016

295. Choose the correct answer
Accelerated electrons can show.
(i) Interference only.
(ii) Diffraction only.
(iii) Both interference and diffraction.
Assam Board-2016

Section-C (Short Answer)

296. Explain the working of Zener diode and draw its V-I graph.
Haryana Board-2017

297. Explain the use of Zener diode as a voltage regulator.
Gujarat Board- March, 2020
J&K Board-2019
Jharkhand Board-2019
Karnataka Board-2018, 2014

298. What is Zener diode? Explain its action as a voltage regulator.
Jharkhand Board-2019

299. With the help of the circuit diagram, explain the working of a p-n junction diode in forward biasing and draw the typical VI characteristics curves.
NIOS-2018

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300. How is Zener diode fabricated? Draw its I-V characteristic and use this to explain the working of a Zener diode as a voltage regulator.

CBSE-2019

301. With what considerations in view is a photodiode fabricated? Explain its working with the help of a suitable diagram. With the help of V-I characteristics, state photodiode is used to detect optical signals.

CBSE-2019

302. What is the reason to operate photodiodes in reverse bias?

A p-n photodiode is fabricated from a semiconductor with a band gap of range of 2.5 to 2.8 eV. Calculate the range of wavelengths of the radiation which can be detected by the photodiode.

CBSE-2019

303. Name the diode which can act as a voltage regulator. Explain its working with the help of its labelled circuit diagram. Draw its V – I characteristic.

CBSE-2020

304. Plot V-I. characteristics for an illuminated photodiode under reverse bias for three different illumination intensities $I_1 > I_2 > I_3$.

CBSE-2020

305. In a zener regulated power supply, a zener diode with $V_Z = 6$ V is used for regulation. The load current should be 4.0 mA and zener current is five times the load current for unregulated input of 10 V. Find the series resistor R_S used in the power supply.

CBSE-2020

306. (a) Draw circuit diagram and explain the working of a zener diode as a dc voltage regulator with the help of its. I-V characteristic.

(a) What is the purpose of heavy doping of p- and n-sides of a zener diode?

CBSE-2020

307. Define input resistance output resistance and current amplification of a transistor.

Karnataka Board-July, 2015

308. What is zener diode? Explain with a diagram how it is used as a voltage regulator.

Uttarakhand Board-2023

309. Drawing circuit diagram, explain the role of Zener diode as a voltage regulator.

Uttarakhand Board-2019

310. Draw diagrams to show how a p-n junction is (a) forward biased and (b) reverse biased. Draw V-I characteristics of the diode in both conditions and show in it break down voltage. Mention one important use of Zener diode.

Assam Board-2013

311. (ii) Write a few lines on any one of the following with purpose of use :

(1) Light emitting diodes

(2) Photovoltaic devices

Assam Board-2023

312. (i) Draw a neat circuit diagram to show a Zener diode acting as a DC voltage regulator. What should be the approximate voltage rating of the diode used in relation to the required output voltage ?

Assam Board-2023

313. What is breakdown voltage of a Zener diode? Explain its use as a voltage regulator.

Assam Board-2015

314. A p-n photodiode is fabricated from a semi-conductor with band gap energy of 2.8 eV. Can it detect a radiation of wavelength of 5000 nm? Why?

Kerala Board-2017

315. What is a zener diode? Give its symbol.

Kerala Board-2016

316. With the help of a circuit diagram, show how a Zener diode can be used as a voltage regulator.

Meghalaya Board-2018

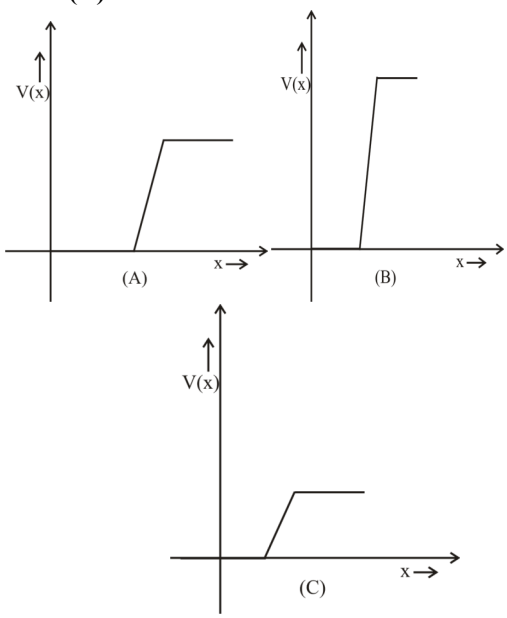
317. Explain the working of n-p-n transistor in common base configuration.

Maharashtra Board-2023

318. The graph of potential barrier V(x) versus width of depletion region (x) for an unbiased p-n junction diode is shown in graph (A)

Graphs (B) and (C) are obtained after biasing the same diode in different ways.

Identify the type of biasing used for graphs (B) and (C).



Goa Board-2019

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Section-D (Case-Based Questions)

319. What is breakdown voltage? With a circuit diagram, explain how a Zener diode can be used as a voltage regulator.

Meghalaya Board-2015

Section-E (Long Answer)

320. What is intrinsic semiconductor ? Explain the process of p-n junction formation with necessary diagram.
Draw the symbol of the following diodes
(i) Zener diode
(ii) P-n junction diode

Rajasthan Board-2023

321. Write short notes
(a) LED
(b) Explain the use of a zener diode as voltage regulator.

MP Board-2020

322. (a) Explain the formation of p-n junction. Draw a diagram for it. Hence define 'Depletion Region' and 'Barrier Potential.'
(d) Draw I-V characteristics for a zener diode. What is its main application?

NIOS-2021

323. What is a Zener diode? With the help of circuit diagram explain how can it be used as voltage regulator.

NIOS-2019

324. What is a Zener diode ? How is it used in voltage regulation ? Explain with a circuit diagram.

UP Board-2017

325. (a) Write the important considerations which are to be taken into account while fabricating a p-n junction diode to be used as a Light Emittig Diode (LED). What should be the order of band gap of anLED, if it is required to emit light in the visible range ? Draw a circuit diagram and explain its action.
(b) Draw the V-I characteristics of an LED. State two advantages of LED lamps over conventional incandescent lamps.

CBSE-2019

326. Describe the construction and characteristics of a Zener diode. Discuss its action as a voltage regulator.

Odisha Board-2023

327. What is a Zener diode? Explain the action of Zener diode as a voltage regulator with relevant circuit diagram.

Karnataka Board-July, 2020

328. What is a photodiode? Explain its working principle. What is a solar cell?

Assam Board-2014

IV. Application of junction Diode as a Rectifier

Section-A (Multiple Choice Questions)

329. Diode can work as
(a) rectifier (b) demodulator
(c) modulator (d) amplifier

Nagaland Board-2021

Ans. (a) :

330. In full wave rectification, what is the output frequency if the input frequency is 50 Hz
(a) 100 Hz (b) 25 Hz
(c) 50 Hz (d) $50\sqrt{2}$ Hz

Gujarat Board- August, 2020

Ans. (a) :

331. In half wave rectification, what is the output frequency if the input frequency is 50 Hz.
(a) 0 (b) 100 Hz
(c) 50Hz (d) 25 Hz

Gujarat Board- March, 2020

Ans. (b) :

332. V_m is the maximum voltage between the ends of the secondary terminal of a transformer used in a half wave rectifier. When the P-N junction diode is reverse biased, what will be the potential difference between the two ends of the diode?
(a) $\frac{V_m}{2}$ (b) Zero
(c) V_m (d) $2V_m$

Gujarat Board- March, 2019

Ans. (b) :

333. When a forward bias is applied to a p-n junction, it
(a) raises the potential barrier
(b) reduces the majority carrier current to zero
(c) lowers the potential barrier
(d) none of the above

Gujarat Board-2023

Ans. (c) :

334. Which device is used as a rectifier?
(a) Junction diode (b) Transformer
(c) Zener diode (d) Photo diode

MP Board-2023

Ans. (a) :

335. The number of diodes used in a half-wave rectifier is
(a) 1 (b) 2
(c) 3 (d) 4

Odisha Board-2022

Ans. (a) :

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Section-B (Very Short Answer)

336. What is Rectifier? Draw circuit diagram of full-wave rectifier.

J&K Board-2018
NIOS-2018

337. What is a rectifier? On what principle does it work?

Jharkhand Board-2023
ISC-2014

338. Draw the circuit diagram of a half-wave rectifier using a p-n junction diode.

ISC-2007

339. Draw the circuit diagram for reverse biasing of a diode using proper symbol for diode (not rectangular block).

ISC-2002

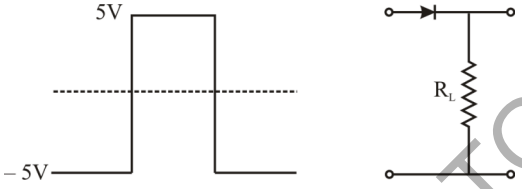
340. Draw circuit diagrams to illustrate forward biasing and reverse biasing of a diode.

Tamil Nadu Board-2011, 2016
ISC-2016

341. What is LED ? Explain how radiation are given out by LED ?

ISC-2005

342. Draw the output signal in a p – n junction diode when a square input signal of 10 V as shown in the figure is applied across it.



CBSE-2019

343. Explain the property of a p-n junction which makes it suitable for rectifying alternating voltages. Differentiate between a half-wave and a full-wave rectifier.

CBSE-2023

344. With the help of a circuit diagram, explain how a full wave rectifier gives output rectified voltage corresponding to both halves of the input ac voltage.

MP Board-2023
CBSE-2023
Uttarakhand Board-2019
Assam Board-2015, 2017, 2019
ISC-2009

345. Give two differences between a half wave rectifier and a full wave rectifier.

Telangana Board-2018
CBSE-2022

346. With the help of a circuit diagram, explain briefly how a p-n junction diode works as a half-wave rectifier.

Assam Board-2023
CBSE-2022

347. What is rectification? Explain the working of a full wave rectifier.

Telangana Board-2015
ISC-2010

348. Distinguish between half and fullwave rectifiers.

Telangana Board-2018

349. Write any two advantages of Light Emitting Diode (LED) over conventional in candescent low power lamps.

Karnataka Board-July, 2018

350. How is a p-n junction diode used as a half wave rectifier? Explain its working with the help of circuit diagram.

Uttarakhand Board-2023

351. (g)How will you dope a pure Silicon Crystal to obtain a p-type and an n-type Semiconductor?

Assam Board-2017

352. With the help of a circuit diagram, explain the use of junction diode as a half -wave rectifier.

Meghalaya Board-2023

Section-C (Short Answer)

353. Explain the construction and working of full wave rectifier.

Tamil Nadu Board-2022

354. Explain the use of P-N diode as full wave rectifier.

Haryana Board-2017

355. What is a rectifier? Explain the working of P-N diode as half wave rectifier.

Gujarat Board- May, 2021, 2023
Haryana Board-2016

356. Draw the circuit diagram of a full-wave rectifier. Explain full-wave rectification in brief. Also draw input-output waveforms.

Gujarat Board-March, 2022

357. Explain the use of P-N junction diode as full wave recitifier on the basis of the following points.
(i) Labelled circuit diagram
(ii) Working method
(iii) Graph between input and output potential with the variation of time.

MP Board-2015

358. What is rectifier? Draw a diagram of electric circuit of half-wave rectifier and draw graph for input voltage and output voltage with time.

Chhattisgarh Board-2022

369. Draw a circuit diagram of a full wave rectifier with a filter circuit. Also show the input and output wave forms.

NIOS-2022

370. Draw a labelled diagram of a full wave rectifier. Show how output voltage varies with time if voltage is a sinusoidal voltage.

ISC-2015

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371. **Show by drawing labelled diagram, the nature of output voltage in case of**
(i) a half-wave rectifier.
(ii) a full wave rectifier.
Circuit diagrams of these devices are not required.
ISC-2013, 2021, 2023

372. **Draw the neatly labelled circuit diagram of a full wave rectifier using two junction diodes.**
ISC-2009

373. **With the help of a circuit diagram, explain briefly the working of a full wave rectifier, which uses two p-n junction diodes.**
ISC-2003

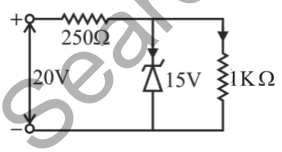
374. **Draw a labelled diagram of a full wave rectifier circuit. Explain briefly the function of its components and sketch the input waveforms.**
ISC-2001

375. **Draw the circuit diagram of a half-wave rectifier using a semiconductor diode. Explain briefly the functions of each component.**
ISC-2000

376. **Draw the circuit diagram of a full wave rectifier. Explain its working principle. Show the input waveforms given to the diodes D_1 and D_2 and the corresponding output waveforms obtained at the load connected to the circuit.**
CBSE-2019

377. **How is a light emitting diode fabricated? Briefly explain the basic processes involved in the emission of spontaneous radiation from it. Write two advantages of LED lamps over the incandescent low power lamps.**
CBSE-2019

378. **Give reason to explain why n and p regions of a Zener diode are heavily doped. Find the current through the Zener diode in the circuit given below : (Zener breakdown voltage is 15 V)**



CBSE-2019

379. **With the help of a circuit diagram, explain the working of a p-n junction diode as a full-wave rectifier. Also draw its input and output waveforms.**
CBSE-2022

380. **With the help of a circuit diagram, explain how tow p-n junction diodes along with a center tapped transformer can be used as a full wave rectifier.**
CBSE-2020

381. **Draw the circuit diagram of a full wave rectifier using two p-n junction diodes. Explain its working and show input and output voltage variations.**
CBSE-2020

382. **(a) In which figure the diode is under forward biased condition ?**

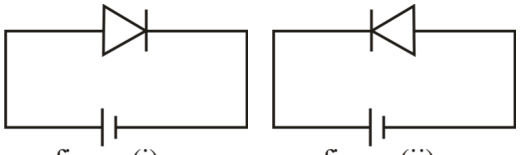


figure (i) figure (ii)

(b) Draw the circuit diagram of a full wave rectifier and explain its working.
Kerala Board-2021

383. **What is the basic principle of a rectifier ? Draw a neat circuit diagram of a full-wave rectifier circuit.**
Meghalaya Board-2019

384. **What is a rectifier ? Using a neat circuit diagram, explain the working of a half-wave rectifier.**
Meghalaya Board-2017

385. **Draw a labeled circuit diagram of a common-emitter transistor amplifier.**
Meghalaya Board-2014

Q.386. **What is a rectifier? With the help of a neat circuit diagram explain the working of a null wave rectifier.**
Maharashtra Board-2020

Section-D (Long Answer)

387. **What is rectification ? Explain the working of a bridge rectifier.**
Tamil Nadu Board-2018

388. **With a neat diagram, explain the working of a Bridge Rectifier. Draw its input and output signals.**
Tamil Nadu Board-2016

389. **What is meant by rectification? Draw an electric circuit diagram of a half wave rectifier. Write a brief description of its working. Draw input and output voltage waveforms for this rectifier circuit.**
Rajasthan Board-2023, 2022

390. **What is a rectifier? Explain with circuit diagram the working principle and output-input wave formation of a full wave rectifier.**
Nagaland Board-2021, 2017

391. **Draw the circuit diagram of a full wave rectifier and explain the working of the circuit.**
Gujarat Board- March, 2019

392. **What is a rectifier? Draw circuit diagram to explain the use of a P-N junction diode as a half wave rectifier.**
MP Board-2020

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393. Describe the working of a P-N junction diode as a half-wave rectifier under the following heads :

(i) Labelled diagram / circuit

(ii) Working method

(iii) Graph of input-output signal with time

Chhattisgarh Board-2018

394. With the help of circuit diagram, explain how a combination of two diodes can be used as rectifier.

NIOS-2019

395. With the help of a circuit diagram, briefly explain the working of a full-wave rectifier using p-n junction diodes.

CBSE-2023

396. Define Rectification. How can a p-n junction diode be used as a full wave rectifier ?

J&K Board-2020

397. What is a P–N junction diode? With a neat circuit diagram, describe the operation of a full-wave rectifier using junction diodes.

Odisha Board-2020, 2022

398. What is rectification? With relevant circuit diagram and wave forms explain the working of p-n junction diode as a full wave rectifier.

Karnataka Board-March, 2016, 2017

Karnataka Board-July, 2014, 2015, 2018

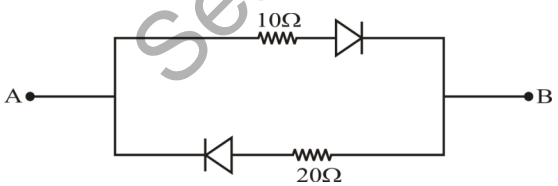
399. What is rectification? Describe with a circuit diagram the working of a p-n junction diode as half wave rectifier with input and output waveforms.

Karnataka Board-July, 2019

400. Biasing is provided for maintaining proper current flow across a p-n junction.

(a) In a _____ biased p-n junction the net flow of holes is from 'n' region to 'p' region.

(b) For the device shown below draw the V-I characteristics when the potential is applied between the terminals A and B.



(c) A transistor can be used to amplify voltage or current. Explain how a transistor can be used as a current amplifier.
Draw necessary circuit.

$\left(2\frac{1}{2}\right)$

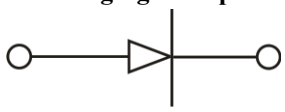
Kerala Board-2013

401. We are familiar with the semi conductors Silicon and Germanium.

(a) With a necessary schematic diagram, briefly explain the characteristics of an intrinsic semiconductor.

(b) Draw the energy bands of a n-type semiconductor.

(c) The following figure represents a



(d) Draw a typical illuminated P-n junction solar cell.

(e) LED convert _____ energy to light.

Kerala Board-2014

402. What is a rectifier? With the help of a neat circuit diagram, explain the working of a half wave rectifier.

Maharashtra Board-2022

V. Transistor

Section-A (Multiple Choice Questions)

403. An oscillator is :

(a) an amplifier with feedback
(b) converter of a.c. to d.c. energy.
(c) nothing but an amplifier
(d) an amplifier without feedback

Tamil Nadu Board-September, 2016

Ans. (a) :

404. In CE single stage amplifier, if the voltage gain at mid-frequency is A_M, then the voltage gain at lower cut of frequency is:

(a) $\frac{A_M}{2}$ (b) $\sqrt{2}A_M$
(c) $\frac{\sqrt{2}}{A_M}$ (d) $\frac{A_M}{\sqrt{2}}$

Tamil Nadu Board-2015

Ans. (d) :

405. The emitter base junction of a given transistor is forward biased and its collector base junction is reverse biased. If the base current is increased, then its:

(a) V_{CE} will increase (b) I_C will decrease
(c) I_C will increase (d) V_{CC} will increase

Tamil Nadu Board-2017

Ans. (c) :

406. Since the input impedance of an ideal operational amplifier is infinite :

(a) its input current is zero
(b) its output resistance is high
(c) its output voltage becomes ndependent of load resistance
(d) it becomes a current controlled device

Tamil Nadu Board-2017

Ans. (a) :

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407. The device that can act as a complete electronic circuit is
(a) junction transistor (b) zener diode
(c) junction diode (d) integrated circuit
Nagaland Board-2017

Ans. (d) :

408. α = 0.99 for a CE transistor amplifier circuit. The input resistance is equal to 1 KΩ and the load resistance is equal to 100 KΩ. The voltage gain of the circuit is.....
(a) 990 (b) 9.9
(c) 9900 (d) 99000
Gujarat Board- March, 2019

Ans. (c) :

409. The emitter junction of the CE transistor amplifier is.....biased, while the collector junction is.....biased.
(a) forward, forward (b) reverse, forward
(c) reverse, reverse (d) forward, reverse
Gujarat Board- March, 2019

Ans. (d) :

410. For an N-P-N transistor in common base circuit about 7% of the electron entering the base from the emitter recombines with the hole. This results in the collector current being 18.6 mA. Calculate the emitter current.
(a) 0.020 A (b) 20 μA
(c) 2 mA (d) 2 A
Gujarat Board- March, 2019

Ans. (a) :

411. The value of current gain β is-
(a) $\frac{\Delta I_b}{\Delta I_c}$ (b) $\frac{I_b}{I_c}$
(c) $\frac{\Delta I_c}{\Delta I_b}$ (d) $\frac{I_c}{I_b}$
MP Board-2017

Ans. (c) :

412. An oscillator is nothing but an amplifier with
(a) Positive feedback (b) Large gain
(c) No feedback (d) Negative feedback
J&K Board-2011

Ans. (a) :

413. In NPN transistor, the maximum current passes through
(a) Collector (b) Emitter
(c) Base (d) Same in all
J&K Board-2011

Ans. (b) :

414 The relation between the transistor parameters α and β is
(a) $\beta = \frac{\alpha}{1-\alpha}$ (b) $\alpha = \frac{\beta}{\beta-1}$
(c) $\beta = \frac{1+\alpha}{\alpha}$ (d) $\alpha = \frac{1+\beta}{\beta}$
Odisha Board-2022, 2023
MP Board-2012

Ans. (a) :

415. Unit of amplification factor of transistor is
(a) Volt (b) ampere
(c) ohm (d) no unit
Bihar Board-2023

Ans. (d) :

116. Which of the following relation is correct for a transistor?
(a) $I_C = I_B + I_E$ (b) $I_B = I_C + I_E$
(c) $I_E = I_B - I_C$ (d) $I_E = I_B + I_C$
Kerala Board-2017

Ans. (d) :

417. In a CE n-p-n transistor when the base current changes from 40 μA to 90 μA, the collector current changes by 7 mA. The value of β is
(a) 7.1 (b) 63
(c) 350 (d) 140
Meghalaya Board-2015

Ans. (d) :

418. For a CE common - Emitter amplifier, the audio signal voltage across the collector resistance of 2 k Ω is 2V. The current amplification factor (β) of the transistor is 100 for the input resistance of 2 kΩ, the input signal voltage will be
(a) 0.02V (b) 0. 1V
(c) 0.01 V (d) 0.001V
Goa Board-2018

Ans. (a) :

Section-B (Very Short Answer)

419. What are 'α' and 'β' parameters of transistor ? What is their relation ?
Bihar Board-2023

420. Draw the circuit symbols for P-N-P and N-P-N transistors.
AP Board-2022

421. Define current gain in C-B Amplifier.
Haryana Board-2018

422. What is the full form of LCD and LED?
NIOS-2016

423. What are the two main merits of a UPS over an inverter?
NIOS-2013

424. How is UPS different from inverter so far as switch-over time is concerned?
NIOS-2012

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425. With the help of a neat, labelled circuit diagram show how n-p-n transistor can be used as an amplifier in the common emitter configuration. Why is a common emitter amplifier preferred over common base amplifier?

NIOS-2016

426. Draw circuit diagram to represent common base configuration of a n-p-n transistor.

NIOS-2016

427. (a) Differentiate between three segments of an n-p-n transistor on the basis of their size and level of doping.

(b) Draw a plot of transfer characteristic and show which portion of the characteristic is used in amplification and why.

CBSE-2019

428. What is junction transistor? Mention its two types. How are they represented?

J&K Board-2016

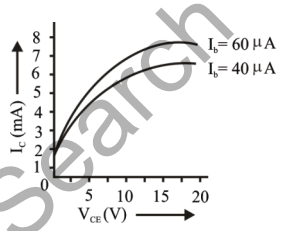
429. For an n-p-n transistor in the common-emitter (CE) configuration, draw a labelled circuit diagram of an arrangement for measuring 'collector current' as a function of 'collector-emitter voltage' for at least two values of the base current. Draw the shapes of the curves obtained. Define the terms (a) output resistance and (b) current amplification factor.

NIOS-2015

430. For a CE transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 2 V. If the current amplification factor of the transistor is 100, calculate the input signal voltage and the base current, given the base resistance as 1 kΩ.

CBSE-2019

431. A certain n-p-n transistor has the common emitter output characteristics as shown in the figure.



(a) Find the emitter current at V_{CE} = 12.5 V and I_b = 60 μA, and

(b) Current gain 'β' at this point.

CBSE-2019

432. Define bandwidth of an amplifier.

Tamil Nadu Board-2017

Tamil Nadu Board-September, 2016

Meghalaya Board-2015

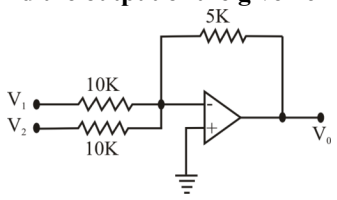
433. When the negative feedback is applied to an amplifier of gain 50, the gain after feedback falls to 25. Calculate the feedback ratio.

Tamil Nadu Board-March, 2016

435. The base current of a transistor is 30 μA and collector current is 15 mA. Determine the value of current gain α.

Tamil Nadu Board-2015

436. Find the output of the given circuit.



Tamil Nadu Board-2016

437. Draw the circuit diagram of NPN transistor in Common Emitter Configuration.

Tamil Nadu Board-2022

438. Draw the circuit diagram of a summing amplifier using an operational amplifier.

Tamil Nadu Board-2017

439. Define current gain in C-E amplifier.

Haryana Board-2016

440. Draw the labelled circuit diagram of a common emitter transistor amplifier. What is meant by phase reversal ?

Jharkhand Board-2018

441. What is meant by the current gain (β) of transistor?

UP Board-2023

442. What is meant by an amplifier ?

ISC-2014

443. Define current gain for a transistor.

ISC-2014

444. Draw the symbol for an n-p-n transistor. What is the direction of the arrow and where is it placed ?

ISC-2003

445. Show graphically the input and output waveforms (with the correct phase relation) for a common-emitter transistor amplifier.

ISC-2003

446. Draw a labelled diagram of

(i) p-n-p and

(ii) n-p-n transistor.

ISC-2001

447. Draw a circuit diagram for the common emitter transistor amplifier. What is meant by phase reversal ?

ISC-2016

448. A sinusoidal voltage e = e_0 sin (ωt) is fed to a common-emitter amplifier. Draw neatly labelled digrams to show

(i) Single voltage and

(ii) Output voltage on amplifier.

ISC-2009

449. Describe briefly (with the help of diagram) a n-p-n or p-n-p transistor.

ISC-2006

Search on TG: @apna_pdf

450. With proper labelling of the axis, draw the input and output characteristic curve of an n-p-n transistor in common-emitter configuration

ISC-2005

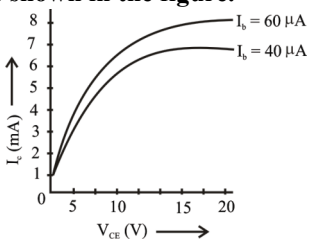
451. Define current gain for a transistor in common-emitter configuration.

ISC-2005

452. Can a transistor be used as a rectifier?

CBSE-2019

453. The output characteristics of an n-p-n transistor in common emitter configuration is as shown in the figure.



(a) Find the emitter current at V_{CE} = 10.0 V and I_b = 40 μA, and

(b) Current gain 'β' at this point.

CBSE-2019

454. Draw the circuit diagram of a p-n-p transistor as an amplifier

J&K Board-2021

455. Draw the circuit symbols for *p-n-p, n-p-n* transistors.

AP Board-2023, 2021

Telangana Board-2018

456. If E_C, E_{Si} and E_{Ge} be the energy gaps between CB and VB of C (diamond), Si and Ge, then which of the following is correct ?

(i) $E_C > E_{Si} > E_{Ge}$

(ii) $E_C < E_{Si} < E_{Ge}$

(iii) $E_C > E_{Si} = E_{Ge}$

Assam Board-2023

Gujarat Board- August, 2020

457. What is the relation between current gain in common emitter and common base mode of transistor as an amplifier ?

J&K Board-2017

Section-C (Short Answer)

458. (a) A common emitter (CE) transistor has a current gain of 100. If emitter current is 8.08 mA, find the base and collector current.

(b) In a sample of semi conductor mobilities of electrons and holes are 24×10^3 cm^2 V^{-1} S^{-1} and 0.2×10^3 cm^2 V^{-1} S^{-1} respectively. If the density of electrons is $08.\times10^{14}$ cm^{-3} and that of holes is 0.4×10^{14} cm^{-3}. Find the nature of semi-conductor and its conductivity.

Punjab Board-2018

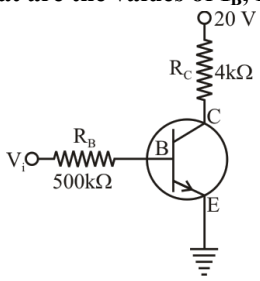
459. Deduce the relation between the current amplification factors α and β of a transistor.

Tamil Nadu Board-2018

460. Define current amplification factors α and β of a transistor. Obtain the relation between them.

Tamil Nadu Board-2016

461. In the circuit shown in the figure, the input voltage V_1 is 20V, V_{BE} = 0 V and V_{CE} = 0V, What are the values of I_B, I_C and β?



Tamil Nadu Board-2023

462. Explain the use of transistor as an amplifier.

Haryana Board-2017

463. Explain the use of N-P-N Transistor as an amplifier in common emitter mode under the following heads

(i) Labelled circuit diagram

(ii) Working

MP Board-2015

465. What is junction transistor? Write two differences between p-n-p and n-p-n junction transistor.

Chhattisgarh Board-2019, 2023

466. A transistor is designated as AC 125, what does this signify? Name the three configurations in which a transistor can be used. Draw a circuit diagram with proper biasing, showing a n-p-n transistor in common base configuration.

NIOS-2022

467. What is a transistor ? By drawing the circuit diagram of common emitter configuration, plot the output characteristics.

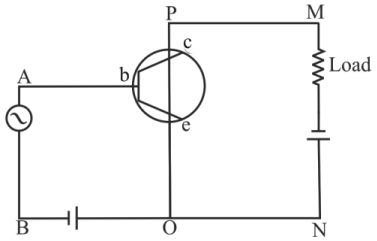
UP Board-2023

468. Figure below shows the circuit of an electronic device,

(i) Which electronic device : a rectifier, an amplifier or an oscillator does the below circuit represent ?

(ii) State where the input voltage is applied and where the output voltage is available

(iii) Compare the output voltage of this circuit with its input voltage.



ISC-2011

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469. **Draw a labelled diagram of a common-emitter amplifier. What is the phase angle between the input and output voltages ?**

ISC-2010

470. **Draw a labelled circuit diagram of a n-p-n transistor in a common-emitter configuration to study its characteristics.**

ISC-2008

471. **Draw the circuit diagram for a common-emitter n-p-n transistor stating the input and output waveforms.**

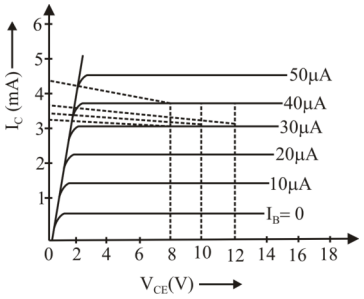
ISC-2004

472. **Output characteristics of an n-p-n transistor in CE configuration is shown in the figure. Determine**

(i) dynamic output resistance

(ii) DC current gain and

(iii) AC current gain at an operating point V_{CE} = 8V, when I_B = 30μA.

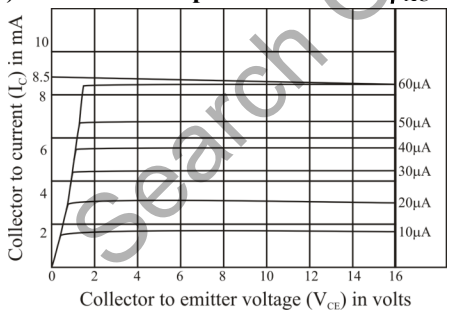


ISC-2004

473. **The typical output characteristics I_C versus V_{CE} of an n-p-n transistor in CE configuration is shown in the figure. Calculate**

(i) the output resistance r_0 and

(ii) the current amplification factor β_{AC}.



ISC-2002

474. **Prove that in a common-emitter amplifier, the output and input differ in phase by 180°**

In a transistor, the change of base current by 30μA produces change of 0.02 V in the base-emitter voltage and a change of 4 mA in the collector current. Calculate the current amplification factor and the load resistance used, if the voltage again of the amplifier is 400.

CBSE-2019

475. **(a) Describe briefly the functions of the three segments of n-p-n transistor.**

(b) Draw the circuit arrangement for studying the output characteristics of n-p-n transistor in CE configuration. Explain how the output characteristic is obtained.

Odisha Board-2020

CBSE-2019

476. **What is an amplifier ? Draw the simple circuit of transistor amplifier in CE mode.**

Karnataka Board-March, 2016

477. **For a Common emitter amplifier the voltage across collector resistance 2kΩ is 2V. If the current amplification factor is 200 and base resistance is 1.5Ω, what is the input voltage? 3**

Assam Board-2016

478. **(h)Explain how a transistor can be used as a switch with the help of a circuit diagram.**

Assam Board-2016

479. **β of a transistor is 120. What is the change in collector current for 100 μA change in base current? Draw at least two input characteristics of a CE mode transistor.**

Assam Board-2015

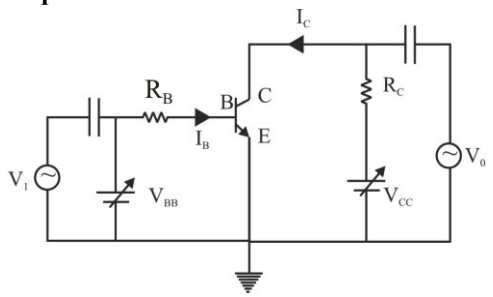
480. **How is a NOT gate realised with the help of a transistor? Given its truth table.**

Assam Board-2015

481. **What is meant by the terms 'depletion layer' and 'potential barrier' for a p-n junction?**

Meghalaya Board-2015

482. **The circuit diagram shows a transistor as an amplifier :**



(i) Why is this configuration of transistor known as common emitter configuration?

(ii) What is the phase difference between the input and the output voltage?

(iii) How does the collector current change when the base current increases?

Goa Board-2023

483. **(a) What is the phase difference between the input and the output voltage in a transistor oscillator circuit ?**

(b) Doping level in the base region of a function transistor amplifier is increased what will be the effect on

(i) base current (ii) collector current

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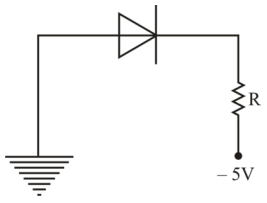
(c) 

(i) State the type of biasing of the diode shown in the figure given above.

(ii) What is the effect of this type of basing on the potential barrier height of the diode

Goa Board-2018

Section-D (Long Answer)

484. With a neat circuit diagram, explain the working of a single stage CE amplifier. Draw the frequency response curve.

Tamil Nadu Board-September, 2016

485. What is an operational amplifier? With a circuit diagram explain, the working of an operational amplifier as a summing amplifier.

Tamil Nadu Board-2015

486. What is meant by feedback? Derive an expression for voltage gain of an amplifier with negative feedback.

Tamil Nadu Board-2017

487. Explain the working of the transistor as an oscillator.

Tamil Nadu Board-2023
Bihar Board-2017
Haryana Board-2016, 2018
UP Board-2017

488. What is a Transistor? How can we uses as an amplifier (Common! Emitter configuration)?

J&K Board-2018

489. Explain with the help of a labelled circuit diagram, the use of the transistor as an oscillator.

Nagaland Board-2018

490. What is an amplifier ? Explain with a circuit diagram the working of an n-p-n transistor as a common emitter amplifier.

Nagaland Board-2017

491. Explain with the help of a labelled circuit diagram, how a n-p-n transistor can be used as an amplifier. Also, explain how the input and output voltage signals are out of phase by 180°.

Nagaland Board-2021

492. What is a transistor ? Explain with circuit diagram, the working of a transistor as an oscillator.

Nagaland Board-2020

493. With the help of a circuit diagram, explain the input and output characteristics of a common emitter n-p-n transistor configuration. State the conclusions drawn from the characteristics curves.

Nagaland Board-2020

494. Give the simple structure of an n-p-n transistor. Show the biasing of an n-p-n transistor and explain the transistor action.

Haryana Board-2018
Nagaland Board-2018

495. Draw a circuit diagram to study characteristics of an n-p-n transistor in common emitter configuration. Draw the sketch of : (i) input characteristics and (ii) output characteristics for this configuration.

Haryana Board-2018

496. Explain the working of a transistor amplifier using its circuit diagram.

Haryana Board-2016, 2018
MP Board-2016

497. Explain the use of a transistor as an oscillator.

Haryana Board-2018

498. What is an oscillator? Draw the circuit diagram of a transistor as an oscillator.

Haryana Board-2016

499. In a N-P-N transistor about 10^{10} electrons enter the emitter in 1 μs when it is connected to a battery. About 2% electrons recombine with the holes in the base. Calculate the values of I_E, I_B, α_{dc} and $\beta_{dc}\left(e = 1.6 \times 10^{-19} C\right)$.

Gujarat Board- March, 2019

500. Explain by drawing a circuit diagram, how is a PNP transistor in common emitter configuration used as an amplifier? Also derive expression for current gain, potential gain.

MP Board-2018

501. What is an oscillator? Explain the use of transistor as oscillator under the following points :

(i) Labelled diagram of circuit
(ii) Principle and working method

Chhattisgarh Board-2018
MP Board-2012

502. Draw the circuit diagram of a common emitter transistor amplifier. In a common emitter amplifier, an increase of 50μA in base current, causes an increase of 1.0 mA in collector current. Calculate the current gain β. Also find the change in emitter current.

Physics constants

Planck's constant (h) = 6.6×10^{-34} J.s
Charge on electron (e) = -1.6×10^{-19} C
Mass of electron (m) = 9.0×10^{-31} kg
Speed of light in vacuum (c) = 3×10^8 m/s

UP Board-2017

503. By drawing the circuit diagram of p-n-p transistor in common emitter configuration, plot the output characteristic curve and explain it.

UP Board-2019
Karnataka Board- March, 2015, 2018, 2019
Assam Board-2013

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504. **(a)** **Draw a circuit diagram of an n-p-n transistor with its emitter-base junction forward biased and base-collector junction reverse biased. Briefly describe its working.**
Explain how a transistor in its active state exhibits a low resistance at its emitter-base junction and high resistance at its base-collector junction.

(b) **Derive the expression for the voltage gain of a transistor amplifier in CE configuration in terms of the load resistance R_L, current gain β_a and input resistance.**
Explain why input and output voltages are in opposite phase.

CBSE-2019

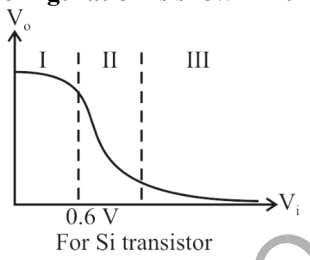
505. **With the help of an circuit diagram, explain the working of npn transistor as a common emitter working of npn transistor as a common emitter amplifier.**

Karnataka Board-July, 2016

506. **Draw a common-emitter amplifier circuit using an n-p-n transistor and explain the amplifier action. Find an expression for a.c. voltage gain.**

Assam Board-2014

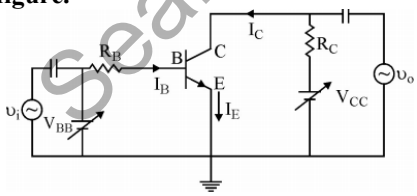
507. **The transfer characteristic of n-p-n transistor in CE configuration is shown in the figure**



(a) **Find the cut off region, active region and saturation region from it.**

(b) **In which of these regions, a transistor is said to be switched off.**

(c) **A CE transistor amplifier is shown in figure.**



In this, the audio signal voltage across collector resistance of 2.0 kΩ is 2.0 V. Suppose the current amplification factor of the transistor is 100. Then calculate the value of signal current through the base.

(d) **In the working of a transistor, the emitter-base (EB) junction is forward biased while collector base (CB) junction is reverse biased. Why?**

Kerala Board-2020

508. **What are α and β parameters for a transistor ? Obtain a relation between them.**

Maharashtra Board-2015

509. **Draw the transfer characteristics of a base-biased transistor in its common emitter configuration.**
Which region of this cahracteristic is used when it works as an amplifier ? With the help of a circuit diagram explain how n-p-n transistor can be used as an amplifier in common-emitter configuration. Hence show that input and output voltages are out of phase by 180°.
The valtage waveforms of inputs A and B of a logic gate are given in the figure. Output Y is shown for time intervals $t_1 - t_2$ and $t_2 - t_3$.

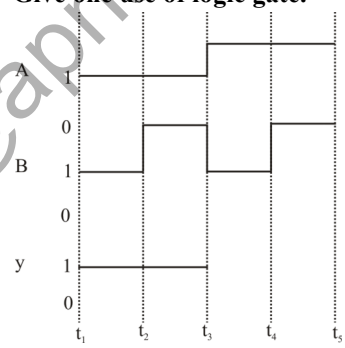
(i) **Identify the logic gate.**

(ii) **Draw its logic symbol.**

(iii) **Using this logic symbol, draw a circuit to obtain logic operation of OR gate.**

(iv) **Draw the output waveform for time intervals $t_3 - t_4$ and $t_4 - t_5$**

(v) **Give one use of logic gate.**



Goa Board-2019

VI. Logic Gate and Boolean Algebra

Section-A (Multiple Choice Questions)

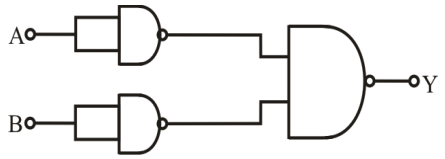
510. **The input values A and B of the Boolean expression $(\overline{A+B})(\overline{A.B}) = 1$ are respectively :**

(a) 1, 0 (b) 0, 0
(c) 1, 1 (d) 0, 1

Tamil Nadu Board-2018

Ans. (a) :

511. **A network of logic gates is shown in the figure.**



(a) **Identify the gates used in this circuit.**

Kerala Board-2017

Ans. () :

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512. The Logic gate for which the output is '1' only when both the inputs are '0' is :

(a) OR (b) NAND
(c) EXOR (d) NOR

Tamil Nadu Board-September, 2016

Ans. (b) :

513. $A\left(\overline{A}+B\right)=?$

(a) A (b) B
(c) AB (d) A + B

Tamil Nadu Board-March, 2016

Ans. (c) :

514. The Boolean expression $\overline{ABC}$ can be simplified as:

(a) $AB+\overline{C}$ (b) $\overline{A}.\overline{B}.\overline{C}$
(c) $AB+BC+CA$ (d) $\overline{A}+\overline{B}+\overline{C}$

Tamil Nadu Board-2015

Ans. (d) :

515. According to the laws of Boolean algebra, the expression (A + AB) is equal to :

(a) A (b) AB
(c) B (d) $\overline{A}$

Tamil Nadu Board-2016

Ans. (a) :

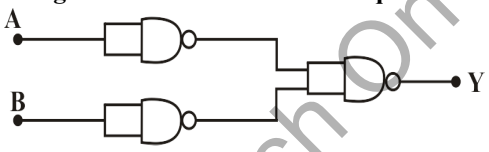
516. A logic gate for which there is an output only when both the inputs are zero is

(a) NAND (b) NOR
(c) EXOR (d) AND

Tamil Nadu Board-2011

Ans. (c) :

517. The given electrical network is equivalent to:

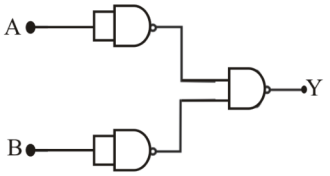


(a) NAND gate (b) OR gate
(c) NOT gate (d) Ex-OR gate

Tamil Nadu Board-2023
NIOS-2017, 2018

Ans. (b) :

518. The output (Y) of the logic circuit show in the figure will be

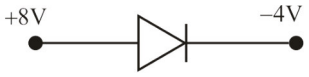


(a) $Y = A + B$ (b) $Y = \overline{A+B}$
(c) $Y = A \cdot B$ (d) $Y = \overline{A \cdot B}$

Rajasthan Board-2023

Ans. (a) :

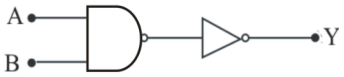
519. Is the Junction diode D is forward or reverse biased, in the given diagram?



Haryana Board-2022

Ans. () : Forward biased

520. Shown in the following figure, circuit act as _____gate



(a) NOT (b) OR
(c) AND (d) NOR

Gujarat Board- August, 2020

Ans. (b) :

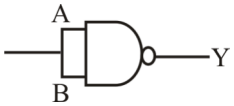
521. Given figure is the symbol of which logic gate?

(a) NOR gate (b) AND gate
(c) NAND gate (d) OR gate

Gujarat Board- March, 2019

Ans. (c) :

522. Given figure is the equivalent of which logic gate?



(a) NOT (b) AND
(c) OR (d) NOR

Gujarat Board-2023

Ans. (c) :

523. Which of the following gates is a universal logic gate?

(a) NOT (b) OR
(c) AND (d) NAND

Bihar Board-2023
NIOS Board-2022
MP Board-2020
Jharkhand Board-2018

Ans. (d) :

524. The logic gate having only one input is

(a) AND (b) OR
(c) NOT (d) NOR

Odisha Board-2022

Ans. (c) :

525. The Boolean expression for NAND gate is–

(a) $Y = A + B$ (b) $Y = A.B$
(c) $Y = \overline{A+B}$ (d) $Y = \overline{A.B}$

Bihar Board-2019

Ans. (d) :

Search On TG: @apna_pdf

526. Which of the following is correct for NOR gate ?

(a) $\overline{A.B} = Y$ (b) $A.B = Y$

(c) $A + B = Y$ (d) $\overline{A + B} = Y$

Bihar Board-2021

Ans. (d) :

527. Which one of the following is correct ?

(a) $(99)_{10} = (1100011)_2$ (b) $(99)_{10} = (1000011)_2$

(c) $(99)_{10} = (1110011)_2$ (d) $(99)_{10} = (1100111)_2$

Bihar Board-2021

Ans. (a) :

528. The binary equivalent of decimal $(15)_{10}$ is

(a) $(1101)_2$ (b) $(1111)_2$

(c) $(110110)_2$ (d) $(1001)_2$

Bihar Board-2021

Ans. (b) :

529. Which of the following is correct for the logic symbol

?

(a) $Y = A + B$ (b) $Y = \overline{A + B}$

(c) $Y = A.B$ (d) $Y = \overline{A.B}$

Bihar Board-2021

Ans. (d) :

530. The binary addition of (1 + 1) is

(a) 1 (b) 10

(c) 100 (d) 11

Bihar Board-2021

Ans. (b) :

531. Basic logic gates are

(a) AND, OR (b) NAND, NOR

(c) OR, NOT (d) AND, OR, NOT

Bihar Board-2021

Ans. (d) :

532. The binary equivalent of 25 is

(a) $(1100)_2$ (b) $(1001)_2$

(c) $(11001)_2$ (d) $(11101)_2$

Bihar Board-2023

Ans. (c) :

533. $Y = \overline{A + B}$ is the Boolean expression for_____.

(a) OR - gate (b) AND - gate

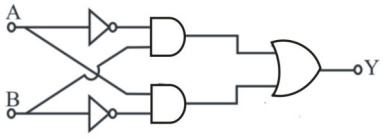
(c) NOR - gate (d) NAND - gate

Maharashtra Board-2023

Ans. (c) :

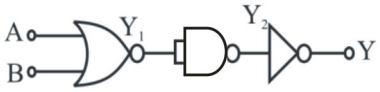
Section-B (Very Short Answer)

534. Give the truth table for the following logic circuit.



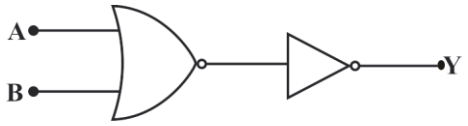
Assam Board-2016

535. What is the equivalent circuit of the combination given below? Answer with proper truth table.



Assam Board-2016

536. For the following combination of logic gates, write down the output at Y given that A = 0 and B = 1 :



Meghalaya Board-2015

537. Prove the Boolean identity : (A + B)(A + C) = A + BC.

Tamil Nadu Board-2018

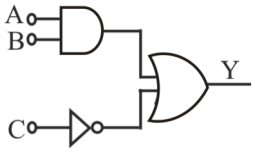
538. What are the advantages of negative feedback ?

Tamil Nadu Board-2018

539. Draw the circuit diagram of OR-gate using diodes.

Tamil Nadu Board-2018

540. What is the Boolean expression for the logic diagram shown in figure. Evaluate its output if A=1, B=1, C=1.



Tamil Nadu Board-September, 2016

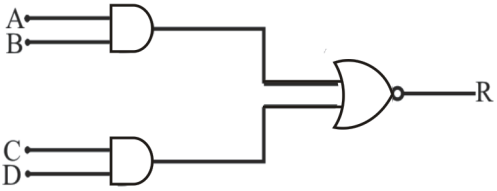
541. What are universal gates? Why are they called so?

Tamil Nadu Board-March, 2016

542. Draw the circuit for NOT gate using transistor.

Tamil Nadu Board-2015

543. Give the Boolean equation for the given logic diagram:



Tamil Nadu Board-2011

544. Draw the logical symbol and truth table of AND an gate.

Odisha Board-2020
Nagaland Board-2020
Haryana Board-2018
Karnataka Board-July, 2014
J&K Board-2012

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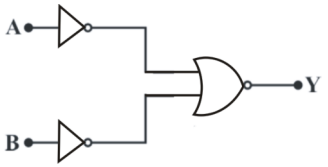
545. A circuit is shown in the figure by combining two NOT gates and one NOR gate. Write the truth table for this connected circuit.



Rajasthan Board-2022

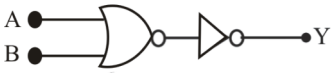
546. How many electron volts make one joule of energy ?

Nagaland Board-2017

547. Write the truth table for the circuit shown in the following Figure. This circuit acts like which gate?

Haryana Board-2018

548. Write the truth table for the circuit shown in the following Figure. This circuit acts like which gate?



Haryana Board-2018

549. What is AND gate? Give its truth table.

Haryana Board-2017

550. Draw symbol and truth table for OR gate.

Nagaland Board-2021
J&K Board-2017
Haryana Board-2017, 2016
Karnataka Board-March-2014

551. Draw the logic symbol and write the truth table for NAND gate.

Gujarat Board- July, 2022
Odisha Board-2022
Karnataka Board-July, 2019, 2016
Karnataka Board-March, 2017, 2016
Assam Board-2014

552. The output of an AND gate is connected to the input of a NOT gate. Draw the logic circuit of this combination of gates and write the truth table.

Jharkhand Board-2020

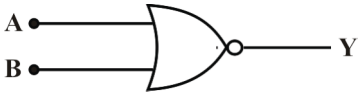
553. Give the symbol and truth table of OR gate and AND gate.

Jharkhand Board-2019

554. Draw the truth table of NAND gate and explain it.

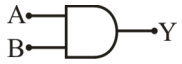
MP Board-2022

555. Write the name of the following logic gate and also make Boolean expression and truth table:



Chhattisgarh Board-2021

556. Write the name of the following logic gate and make truth table :



Chhattisgarh Board-2018

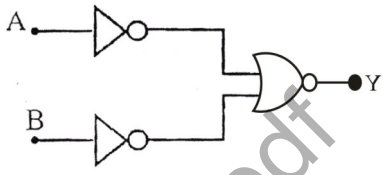
557. Name the logic gate which performs (a) multiplication and (b) inversion operation.

NIOS-2013

558. Distinguish between continuous and digital signals.

NIOS-2018

559. (i) Make truth table of following combination of logic gates.



(ii) Name the basic gate equivalent to this combination.

NIOS-2019

560. Draw the logic symbols and write Boolean expressions for OR, AND, NAND and NOR gates

UP Board-2017

561. Deduce the Boolean expression for the output (Y) of the following logic gate.

Or

Draw symbol diagram and truth table of NOR gate.

UP Board-2020

562. What is the difference between analog signal and digital signal ?

ISC-2016

563. Show the variation of voltage with time, for a digital circuit.

OR

Draw a labelled graph of voltage versus time for a signal voltage used in digital circuits.

ISC-2010

564. With the help of a diagram, show how can you use several NAND Gates to obtain an OR Gate.

ISC-2014

565. Identify the logic gate whose truth table is given below and draw its symbol.

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

ISC-2013

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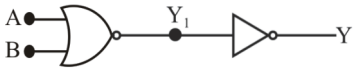
566. The following combination of gates acts as a logic gate. With the help of a truth table, find out which logic gate the combination represents.

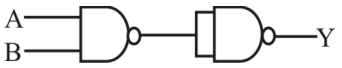


ISC-2012

567. Using several NAND gate, how can you obtain an AND gate ? Draw a labelled diagram in support of your answer.

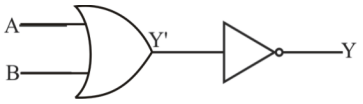
ISC-2012, 2011

568. Prepare a truth table for the combination of gates shown in figure below



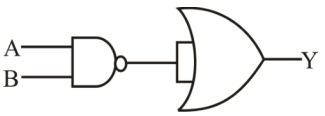
ISC-2011

569. The output of a OR gate connected to a NOT gate as shown in the figure given below. Name the new gate formed. Draw the logic symbol and truth table of the new gate.



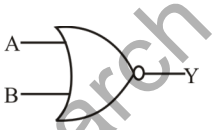
ISC-2005

570. Write down the truth table of the following combination of logic gates.



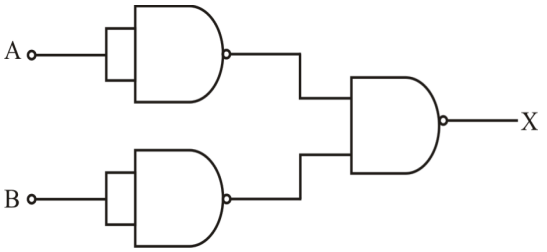
ISC-2003

571. Name the logic gate shown in the figure given below. Write its truth table and Boolean equation.



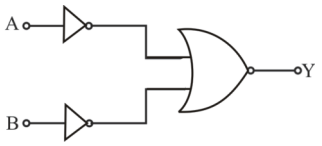
ISC-2001

572. Identify the equivalent gate for the circuit of a combination of gates shown in the figure. Write its symbol.



CBSE-2019

573. Draw the logic symbol of the gate shown by the combination of gates and write its name.



CBSE-2019

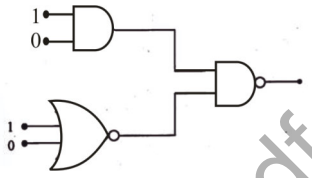
574. Give Boolean Expression and truth table of NOR gate.

J&K Board-2021, 2011

575. Which logic gate known as universal gate ?

Odisha Board-2023, 2020
Telangana Board-2015

576.



What is the output of this combination?

Karnataka Board-July, 2018

577. Inputs of NAND gates are A = 1, B = 0. What is the output?

Karnataka Board-July, 2015

578. Mention any one application of light emitting diode(LED)?

Karnataka Board-July, 2014

579. Which logic gate used as inverter?

Karnataka Board-July, 2020

580. Write truth tables of Universal logic gates.

AP Board-2020

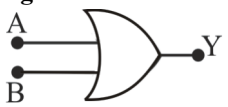
581. Write truth table and Boolean expression of OR and AND gate.

Bihar Board-2019

582. Write down truth table and Boolean expression for NOR and NAND gates.

Bihar Board-2023
AP Board-2023, 2022, 2021
Uttarakhand Board-2019
Meghalaya Board-2017

583. The symbol of a logic gate is given below. Identify the gate and write its truth table.



Kerala Board-2021

584. Mention one practical application of logic gates.

Meghalaya Board-2019

586. Write the Boolean expression for Exclusive-OR (X–OR) gate.

Maharashtra Board-2022

587. Name the logic gate which generates high output when at least one input is high.

Maharashtra Board-2019

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Section-C (Short Answer)

588. **(a) Write the truth table of AND gate.**
(b) What is rectifier? Explain the working of p-n junction diode as a full-wave rectifier with the help of suitable circuit diagram.
Punjab Board-2018

589. **State and prove De Morgan's theorems.**
Tamil Nadu Board-2018, 2017

590. **Modulation helps to reduce the antenna size in wireless communication - Explain.**
Tamil Nadu Board-2023

591. **Give the truth table. Logic symbol and Boolean expression of OR gate.**
Chhattisgarh Board-2023
J&K Board-2022

592. **Draw the logic symbol and give the truth table of NAND gate. Why this gate is called universal gate. 3**
Gujarat Board- March, 2020

593. **Write the logic symbols and prepare the truth tables of the following gates.**
(i) AND (ii) NOR
MP Board-2015

594. **How will you obtain OR, AND gates from the NAND and NOR gates? Write symbol, Boolean formula and truth table.**
MP Board-2015

595. **What is meant by logic gates? Write Symbol, Boolean formula and Truth table for OR, AND and NOR gates.**
MP Board-2022

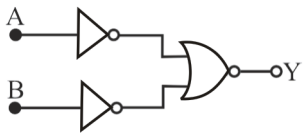
596. **Identify the logic gates denoted by X and Y in the figure and write the truth table.**

Chhattisgarh Board-2022

597. **Write the name and Boolean equation of the following logic gate and make the truth table:**

Chhattisgarh Board-2019

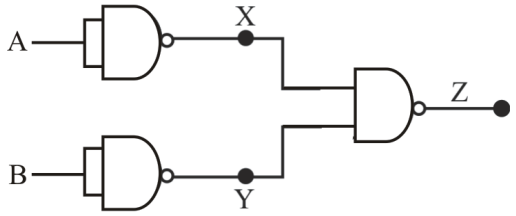
598. **Show that the given logic circuit works like an AND gate.**



UP Board-2019

599. **What is NOR gate? Draw its logic symbol and obtain truth table.**
UP Board-2023
Odisha Board-2023
Gujarat Board-March, 2022
Karnataka Board-March, 2020
J&K Board-2019, 2015, 2014
ISC-2009

600. **Make a truth table showing inputs at A and B and outputs at X, Y and Z for the combination of gates shown in figure below.**

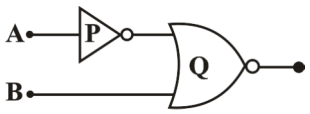


ISC-2009

601. **Why is a NAND gate called a universal gate ? Show how an AND gate can be obtained using one or more NAND gates.**
ISC-2008

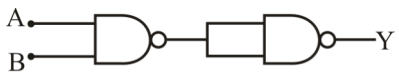
602. **What is meant by analog and digital signals ? What is the symbol for a XOR gate ?**
ISC-2007

603. **(a) (i) Write the truth tables of the logic gates marked P and Q in the given circuit.**
(ii) Write the truth table for the circuit,

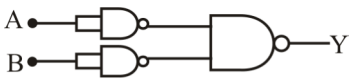


(b) Why are NOR gates considered as universal gates ?
CBSE-2019

604. **You are given two circuits as shown in figure, which consists of NAND gates. Identify the logic operation carried out by the two circuits.**



(a)



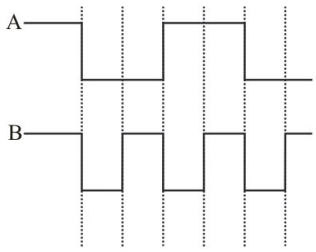
(b)

Uttarakhand Board-2020

605. **Draw the logic symbol of OR gate, AND gate and NOT gate and give their truth table.**
Uttarakhand Board-2022

606. **Sketch the output Y from NAND gate having input A and B given below:**

Search On TG: @apna_pdf



Uttarakhand Board-2019

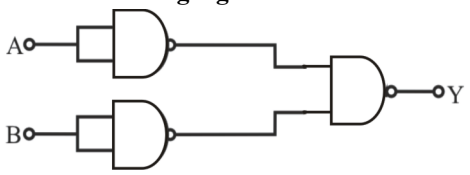
607. Sketch inputs A, B and output Y from a NAND gate from the table given below.

Time	Input A	Input B
$t < t_1$	1	1
t_1 to t_2	0	0
t_2 to t_3	0	1
t_3 to t_4	1	0
t_4 to t_5	1	1
t_5 to t_6	0	0

(*i*) How will you detect amplitude modulated waves? Explain with block diagram. 3

Assam Board-2017

608. A network of logic gates is shown in the figure.

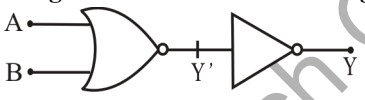


(a) Identify the gates used in this circuit.

(b) Write the truth table of this combination of gates.

Kerala Board-2017

609. A logic circuit is shown in the figure:



Complete the truth table of the circuit:

A	B	Y'	Y
0	0	1	0

Name the resulting gate formed by the combination of the above gates.

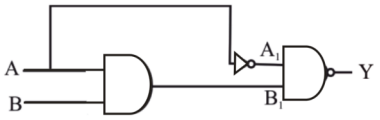
Kerala Board-2016

610. Draw the logic gate symbols and the truth tables for an AND gate and a NOR gate with two inputs.

Meghalaya Board-2014

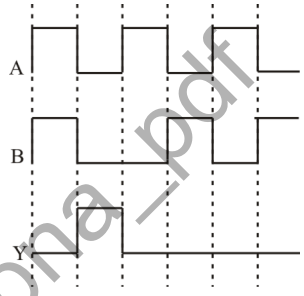
611. Refer the given circuit diagram. Using the given inputs, write the truth table to get the output Y

A	B
0	0
0	1
1	0
1	1



Goa Board-2023

612. The following figure shows the input waveforms A, B and the output waveform Y of a gate. Identify the gate and draw its logic symbol.



Goa Board-2018

Section-D (Long Answer)

613. Give the logic symbol, truth table and Boolean expression for AND gate. How is it realized in practice ?

J&K Board-2018

614. What is main logic gates? How many types are they? Draw their symbols and Truth Table.

(Long Answer Type Questions) (6 marks each)

MP Board-2012

615. Explain OR gate and AND gate on the basis of following points:

(i) Symbol

(ii) Truth Table

(iii) Boolean expression

MP Board-2017

616. How will you obtaind AND, OR and NOR gates by using NAND and NOT gates? Write symbol. Boolean formula and truth table.

MP Board-2018, 2019

617. What is meant by logic gates? What are OR and AND gates? Draw their symbols and electrical equivalent circuits.

MP Board-2021

618. Draw an OR gate using two diodes, explain its working and write its truth table.

J&K Board-2020

619. (c) Write the truth table of an OR gate having two inputs.

Meghalaya Board-2013

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15. Communication Systems

I. Communication systems

Section-A (Multiple Choice Questions)

1. IN optical fiber, The refractive index of the material of the core is — that of the cladding.
(a) less than (b) higher than
(c) equal to (d) half
Gujarat Board- March, 2020

Ans. (a) :

2. Intermediate frequency of FM receiver :
(a) 10.7 MHz (b) 455 kHz
(c) 455 MHz (d) 10.7 kHz
Tamil Nadu Board-2018

Ans. (a) : j

3. Printed documents to be transmitted by fax are converted into electrical signals by the process of:
(a) Modulation (b) Reflection
(c) Light variation (d) Scanning
Tamilnadu Board-2018
Tamilnadu Board - 2016

Ans. (d) : j

4. In amplitude modulation, the bandwidth is:
(a) equal to the signal frequency
(b) twice the signal frequency
(c) thrice the signal frequency
(d) four times the signal frequency
Tamil Nadu Board-March, 2016

Ans. (b) : j

5. The main purpose of modulation is to:
(a) combine two waves of different frequencies.
(b) acquire wave shaping of the carrier wave.
(c) transmit low frequency information over long distances efficiently
(d) produce side bands.
Tamil Nadu Board-2015

Ans. (c) : j

6. The variation of frequency of carrier wave with respect to the instantaneous amplitude of the modulating signal is called :
(a) Phase modulation
(b) Amplitude modulation
(c) Pulse width modulation
(d) Frequency modulation
Tamil Nadu Board-2022

Ans. (d) :

7. The RF channel in a radio transmitter produces:
(a) audio signals
(b) high frequency carrier waves
(c) both audio signal and high frequency carrier waves
(d) low frequency carrier waves
Tamilnadu Board-2017
Tamilnadu Board - 2015

Ans. (b) : j

8. The resting frequency of FM transmitter is 98.5 MHz. The allowed minimum and maximum frequency on either side of centre frequency are respectively:
(a) 98.400 MHz and 98.600 MHz
(b) 98.450 MHz and 98.550 MHz
(c) 98.425 MHz and 98.575 MHz
(d) 98 MHz and 99 MHz
Tamil Nadu Board-2017

Ans. (c) : j

9. The frequency range of 30 MHz to 400 GHz is used for:
(a) Satellite communication
(b) Ground wave propagation
(c) Space wave propagation
(d) Sky wave propagation
Tamil Nadu Board-2023

Ans. (c) : j

10. UHF range can propagate by means of:
(a) Ground wave (b) Sky wave
(c) Surface waves (d) Space waves
Bihar Board-2023
J&K Board-2018

Ans. (d) :

11. Modem is a device which performs
(a) Modulation
(b) Rectification
(c) Dc-modulation
(d) Modulation and demodulation.
J&K Board-2015

Ans. (d) :

12. Communication frequency band range for FM broadcast is-
(a) 530 – 1710 MHz (b) 540 – 890 MHz
(c) 88 – 108 MHz (d) 54 – 85 MHz
Rajasthan Board-2023

Ans. (c) :

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13. The height of a T.V. tower is 32 m. If radius of earth is 6400 km, then what is the maximum distance of transmission from it?

(a) $6.4\sqrt{10}$ km (b) $64\sqrt{10}$ km

(c) 64 km (d) 640 km

Haryana Board-2018

Ans. (a) :

14. The height of a T.V. tower is 100 m. If radius of earth is 6400 km, then what is the maximum distance of transmission from it?

(a) 100 km (b) $64\sqrt{10}$ km

(c) $6.4\sqrt{10}$ km (d) $8\sqrt{20}$ km

Haryana Board-2018

Ans. (d) : j

15. The height of a T. V. tower is 50 m. If radius of earth is 6400 km, what is the maximum distance of transmission from it?

(a) 64 km (b) $8\sqrt{10}$km

(c) $64\sqrt{10}$km (d) 640 km

Haryana Board-2018

Ans. (b) : j

16. The distance of transmission by a TV tower of height h is given by (R = radius of earth):

(a) $\sqrt{Rh}$ (b) $\sqrt{2Rh}$

(c) $\sqrt{R/h}$ (d) None

Haryana Board-2018

Ans. (b) : j

17. A TV tower is of height h, the distance upto which it can broadcast program will be (Given radius of earth: R):

(a) Rh (b) 2Rh

(c) $\sqrt{2Rh}$ (d) $\sqrt{Rh}$

Haryana Board-2017

Ans. (c) : j

18. Which layer of atmosphere reflects radio waves?

(a) Chromosphere (b) Mesosphere

(c) Ionosphere (d) None

Haryana Board-2016

Ans. (c) : j

19. The maximum distance to which transmission can be made by a TV tower at height h is given by (Given R is radius of earth):

(a) $\sqrt{Rh}$ (b) $\sqrt{R/h}$

(c) $\sqrt{2Rh}$ (d) None

Haryana Board-2016

Ans. (c) : j

20. Which of the following devices converts message signals into equivalent electrical signals?

(a) Converter (b) Transformer

(c) Transducer (d) Inverter

Jharkhand Board-2018

Ans. (c) : j

21. Optical fibre has a bandwidth of

(a) 100 Hz (b) 100 kHz

(c) 100 MHz (d) 100 GHz

Jharkhand Board-2018

Ans. (d) : j

22. The sound signal produced by a tunning fork is:

(a) only digital

(b) only analog

(c) both analog and digital

(d) neither digital nor analog

MP Board-2018

Ans. (b) : j

23. The radio waves received after reflection from ionosphere are:

(a) Ground waves (b) Sky waves

(c) Space waves (d) Surface waves

J&K Board-2019

Ans. (b) : j

24. The modulation used in TV transmission is

(a) amplitude modulation

(b) frequency modulation

(c) phase modulation

(d) None of the above

Odisha Board-2020

Ans. (a) : j

25. The modulation producing minimum noise is

(a) amplitude modulation

(b) frequency modulation

(c) phase modulation

(d) none of the above

Odisha Board-2022

Ans. (b) : j

26. The height of TV tower at a contain place is 245 m. The maximum distance up to which its programme can be received is-

(a) 245 m (b) 245 km

(c) 56 km (d) 112 km

Bihar Board-2019, 2022

Ans. (c) : j

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27. The modulation index in amplitude modulation–
(a) is always zero
(b) lies between (0 and 1)
(c) lies between 1 and ∞
(d) can never exceed 0.5

Bihar Board-2019

Ans. (b) : j

28. Attenuation is measured in
(a) decibel (b) symon
(c) ohm (d) tesla

Bihar Board-2022

Ans. (a) : j

29. Frequency range for ground waves should be
(a) more than 100 MHz
(b) less than 0 MHz
(c) more than 10^5 MHz
(d) less than 1500 kHz

Bihar Board-2022

Ans. (d) : j

30. Modem is a device used for
(a) modulation
(b) demodulation
(c) rectification
(d) both modulation and demodulation

Bihar Board-2022
J & K Board - 2015

Ans. (d) : j

31. Which range of frequency is used in TV transmission ?
(a) 30 Hz - 300 Hz (b) 30 kHz - 300 kHz
(c) 30 MHz - 300 MHz (d) 30 GHz - 300 GHz

Bihar Board-2023

Ans. (c) : j

32. Which of the following optical phenomena is used in the transmission of light through an optical fibre ?
(a) Scattering of light
(b) Total internal reflection
(c) Interference of light
(d) Diffraction

Meghalaya Board-2017

Ans. (b) : j

33. The reflected waves from an ionosphere are__ .
(a) ground waves
(b) sky waves
(c) space waves
(d) very high frequency waves

Maharashtra Board-2018

Ans. (b) : j

34. The maximum distance upto which TV transmission form a TV tower of height h can be received is proportional to
(a) $h^{1/2}$ (b) h
(c) $h^{3/2}$ (d) h^2

Goa Board-2019

Ans. (a) : j

Section-B (Very Short Answer)

35. Define ground wave propagation
J&K Board-2019

36. Explain ground wave propagation.
Punjab Board-2018

37. Give the basic function of antenna.
Punjab Board-2018

38. Give the advantages of digital communication system.
Tamil Nadu Board-2018

39. Define amplitude and frequency modulation.
Haryana Board-2017

40. What type of communication is used for Television ?
J&K Board-2017

41. Define De-modulation.
J&K Board-2017

42. Bulk of power in an AM wave is carried by…….
J&K Board-2014, 2015

43. What are the advantages and disadvantages of Frequency modulation?
Tamil Nadu Board-September, 2016

44. Write any three merits of satellite communication.
Tamil Nadu Board-September, 2016

45. What are the merits and demerits of satellite communication system?
Tamil Nadu Board-2015

46. Mention any three advantages of fibre optical communications system.
Tamil Nadu Board-2015

47. Write any three merits of satellite communication.
Note :
(i) Answer question number 60 compulsorily.
(ii) Answer any six of the remaining 11 questions.
(iii) Draw diagrams wherever necessary.
(iv) Tamil Nadu Board-2016

48. What are the different types of radiowave propagation?
Tamil Nadu Board-2017

49. Define modulation factor.
Tamil Nadu Board-2011

50. Explain sky wave propagation.
J&K Board-2018

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51. What do you mean by (i) ground wave (ii) sky wave ?
J&K Board-2017

52. Why sky wave propagation of electromagnetic waves cannot be used for TV transmission?
J&K Board-2016

53. What is Modulation? Define amplitude modulation.
J&K Board-2016

54. Sky wave propagation is not possible for waves having frequency greater than 30 MHz. Explain.
J&K Board-2012

55. What are Optical Fibres? How light waves are propagated in them?
J&K Board-2012

56. Name the physical principle on which the working of optical fibre is based.
ISC-2016, 2014, 2000

57. Why ground waves are not suitable for high frequency ?
J&K Board-2022

58. Define amplitude modulation.
J&K Board-2023

59. Write any two factors which justify the need for modulating a signal.
J&K Board-2023

60. Draw a labelled block diagram for demodulation of amplitude modulated wave.
J&K Board-2023

61. What are line communication and space communication? Given examples of each.
Nagaland Board-2018

62. State two factors by which the range of TV signals can be increased.
Nagaland Board-2017

63. Draw and label the block diagram of a generalized communication system.
Nagaland Board-2021

64. What is meant by point-to-point and broadcast modes of communication ? Give one example each.
Nagaland Board-2021

65. What is the use of transducer in communication system ?
Nagaland Board-2020

66. What is Demodulation? Give block diagram of detector for AM signal.
J&K Board-2023
Haryana Board-2018
MP Board-2015

67. What is Modulation? Explain its necessity giving example of size of antenna.
Haryana Board-2018
J&K Board-2012

68. Explain amplitude modulation by using diagram.
Haryana Board-2018

69. What is a transducer?
Haryana Board-2018

70. What is frequency modulation? Explain with diagram.
Haryana Board-2017

71. What is modulation? Explain frequency modulation with the help of a diagram.
Haryana Board-2018, 2016

72. A radio can tune into any station in the 7.5 Mllz to 12 Mllz band. What is the corresponding wave length band?
Gujarat Board- August, 2020

73. Define Modem. With the help of a block diagram, diagram explain the function of modem between two computers.
Jharkhand Board-2020

74. What do you understand by communication system? What are its essential elements?
Jharkhand Board-2020

75. What do you mean by space wave propagation and sky wave propagation?
Jharkhand Board-2019

76. What is modulation? Why is modulation needed?
J&K Board-2020
Jharkhand Board-2018
Karnataka Board-July, 2015

77. What are carrier waves? Why do we need the carrier waves of high frequency for distant communication?
MP Board-2013

78. What is meant by population inversion and optical pumping?
MP Board-2013

79. Write the meaning of laser and two uses.
MP Board-2014

80. Write any two advantages of optical communication
MP Board-2014

81. Differentiate analog signal and digital signal with diagrams.
MP Board-2015

82. A.T.V. antenna is of height h metre. Show that it can be used to transmit the signal up to the distance d = $\sqrt{2hR}$ on the earth surface, where R is the radius of earth.
MP Board-2015

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83. What is meant by 'LASER' ? State its two uses.
MP Board-2015

84. Why modulation is necessary? Explain.
MP Board-2017

85. Give two characteristics of laser rays.
MP Board-2017

86. Draw block diagram of MODEM.
2
MP Board-2018

87. Draw block diagram of FAX machine.
MP Board-2018

88. Who invented the television transmission?
MP Board-2018

89. Write name of elements of communication system.
MP Board-2019

90. It is necessary to used satellites for long distance T.V. transmission. Why?
MP Board-2020

91. Write two differences between transmitter and receiver in communication devices.
Chhattisgarh Board-2023

92. Can it possible the audio frequency waves be transmitted through free space? Give reason.
Chhattisgarh Board-2022

93. What is modulation? Why is it necessary in communication system for sending a message?
Chhattisgarh Board-2021

94. Microwaves are suitable for long distance transmission signal, way?
Chhattisgarh Board-2021

95. Write two differences between Analog and Digital Signals. [2]
Chhattisgarh Board-2020

96. What is Sky Wave Propagation? Write suitable frequency range for this propagation.
Chhattisgarh Board-2019

97. What are two basic components of a communication system? Draw a block diagram of schematic arrangement for the communication system.
NIOS-2012

98. Calculate the wavelength of a wave of frequency 40 MHz propagating in a medium. [Speed of light = 3×10^8 m s^{-1}]
NIOS-2013

99. What are the main components of a communication system ? Show them by using a block diagram.
UP Board-2017

100. What is modulation index ?
UP Board-2017

101. Write the function of receiver in communication system.
CBSE-2019

102. Define the term 'attenuation' in communication system.
CBSE-2019

103. The frequencies of two side bands in an amplitude modulated wave are 640 kHz and 660 kHz respectively. Find the frequencies of the carrier and the modulating signals. Also obtain the value of the bandwidth required in amplitude modulation.
CBSE-2019

104. A sinusoidal carrier voltage is amplitude modulated by a sinusoidal voltage of 10 kHz with modulation index 0.3. If the carrier frequency is 10 MHz and its amplitude is 40 V, calculate the frequency and amplitude of the two sidebands.
CBSE-2019

105. Draw a block diagram of a generalized communication system and write the functions of (i) a transmitter, and (ii) a receiver.
CBSE-2019

106. Why is the sky wave transmission of signals restricted to a range of frequencies up to 30 MHz?
CBSE-2019

107. Why is ground wave transmission of signals restricted to a frequency of 1500 kHz?
CBSE-2019

108. Define amplitude modulation in communication system.
CBSE-2019

109. Write the relation between the height of a TV antenna and the maximum range up to which signals transmitted by the antenna can be received. How is this expression modified in the case of line of sight communication by space waves ? In which range of frequencies, is this mode of communication used ?
CBSE-2019

110. Why a signal transmitted from a TV tower cannot be received beyond a certain distance? Write the expression for the optimum separation between the receiving and the transmitting antenna.
CBSE-2019

111. Draw the pattern of electric field lines when a point charge +q is kept near an uncharged conducting plate.
CBSE-2019

112. In sky wave mode of propagation, why is the frequency range of transmitting signals restricted to less than 30 MHz?
OR

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On what factors does the range of coverage in ground wave propagation depend?

CBSE-2019

113. (a) (i) Long distance radio broadcasts use short-wave bands. Why ?
(ii) The experimental demonstration of electromagnetic waves is possible only in the low frequency region (the radio wave region). Explain.

CBSE-2022

114. What is Sky Wave Propagation?

J&K Board-2011

115. Mention differences between amplitude and frequency modulation.

J&K Board-2011

116. What is Sky wave? Where it is used?

J&K Board-2021

117. What is Amplitude modulation?

J&K Board-2021

118. Why sky waves are not used for transmission of TV signals?

J&K Board-2019

119. Each question carries four marks.
iii) All are short answer type questions.

120. Define critical angle. Explain total internal reflection using a neat diagram.

Telangana Board-2015

121. What is modulation? Mention the basic methods of modulation.

Telangana Board-2015

122. Draw the block diagram of generalized communication system.

Karnataka Board-March, 2015, 2017
Assam Board - 2016
Karnataka Board-July, 2015
Maharashtra Board-2015

123. What is attenuation in communication system?

Karnataka Board-March, 2017, 2015

124. Draw a block diagram showing the important components in a generalized communication system.

Karnataka Board-July, 2019

125. Mention one need for modulation.

Karnataka Board-July, 2019

126. Draw the block diagram of a AM receiver.

Karnataka Board-March, 2017
Karnataka Board-July, 2015, 2016
Karnataka Board - 2015

127. Why sky wave propagation is not possible for waves having frequency more than 30 MHz?

Karnataka Board-July, 2016

128. What is Amplification?

Karnataka Board-July, 2014

129. Give an expression for range of an antenna of its height from ground.

Karnataka Board-July, 2014

130. Why there is need for modulation?

Karnataka Board- March, 2014

131. Give the bandwidth of TV signal for transmission.

Karnataka Board- March, 2014

132. Draw a labelled diagram of Amplitude modulated wave and write the formula of modulation index.

Uttarakhand Board-2019

133. Mention the frequency range of speech signals.

AP Board-2020

134. Mention the basic methods of modulation.

AP Board-2023, 2022, 2021

135. What do you mean by ground waves ?

Bihar Board-2021

136. Define modulation. Write its types.

Bihar Board-2023

137. Draw a labelled block diagram of a radio transmitter.

Assam Board-2014

138. What are the different transmission media for communication? Give their bandwidth.

Assam Board-2017

139. (h)What are the different components of a TV Signal? Write down the bandwidth of speech and TV signal.

Assam Board-2017

140. For an AM wave, the maximum amplitude is found to be 10V while the minimum amplitude is found to be 2V. Determine the modulation index.

Assam Board-2016

141. (j)Draw the block diagram of a generalized communication system.

Assam Board-2016

142. The transmitting antenna at the top of a tower has a height of 32m. The height of the receiving antenna is 50m. What is the maximum distance between them for satisfactory LOS mode Communication? Radius of earth is 6.4×10^3 km

Assam Board-2016

143. In a Communication System, what do you mean by (i) Transducer and (ii) Signal?

Assam Board-2016

144. (h)What is Communication?

Assam Board-2016

145. The given figure shows the various propagation modes of e.m. waves in communication.

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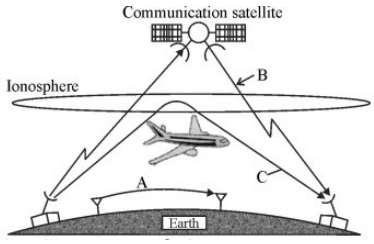

(a) Write the names of propagation modes in A, B, C.

(b) Why transmission of TV signals via sky wave is not possible?

Kerala Board-2020

146. Draw the labelled block diagram of an amplitude modulator for obtaining AM wave.

Kerala Board-2016

147. Why VHF, UHF and microwaves cannot be transmitted by sky wave propagation ?

Meghalaya Board-2019

148. What is carrier wave ?

Meghalaya Board-2019

149. In an amplitude modulated wave, the change in the amplitude of the carrier wave is A. Given the modulation factor to be 1, find the amplitude of the unmodulated carrier wave.

Meghalaya Board-2017

150. Draw a block diagram showing the basic elements of a communication system. What is demodulations?

Meghalaya Board-2017

151. What should be the coverage range of a transmitting antenna of height 500 m ? [Given the radius of earth $R = 6.4 \times 10^6$m.]

Meghalaya Board-2017

152. Give one reason why ground wage propagation is not suitable for transmission of high frequency radio- waves.

Meghalaya Board-2015

153. Why is modulation essential for long distance transmission of signal?

Meghalaya Board-2014

154. Explain the terms (a) Transducer and (b) Attenuation in communication system.

Maharashtra Board-2019

155. Write a short note on sky wave propagation.

Maharashtra Board-2020

156. What is attenuation in communication system?

Maharashtra Board-2020

157. Write any one factor that prevents a baseband signal of low frequency to be transmitted over long distance directly.

Goa Board-2019

Section-C (Short Answer)

158. Explain the function of Frequency modulated radio transmitter with a block diagram.

Tamil Nadu Board-2016

159. A 10 MHz sinusoidal carrier wave of amplitude 10 mV is modulated by a 5 kHz sinusoidal audio signal wave of amplitude 6mV. Find the frequency components of the resultant modulated wave and their amplitudes.

Tamil Nadu Board-2017

160. Explain the function of FM transmitter with neat block diagram.

Tamil Nadu Board-2011

161. Discuss Sky and Space wave propagation.

J&K Board-2014, 2015

162. Draw the block diagram of data transmission and data reception.

J&K Board-2022

163. Explain the sky wave propagation of radio waves.

J&K Board-2023

164. Distinguish between sky wave and space wave propagations. Explain with the help of suitable diagram indicating how these waves are propagated.

Nagaland Board-2018

165. With the help of a block diagram of a detector for an amplitude modulated signal, explain the function of each components.

Nagaland Board-2017

166. A TV tower has height 'h'. Derive an expression for the maximum distance up to which the signal can be received from the antenna. What is the area and population covered by the signal ?

Nagaland Board-2021

167. Draw the block diagram of a receiver of AM radio wave. Explain each of the components used.

Nagaland Board-2020

168. A modulating signal of frequency 5 KHz and peak voltage of 5V is used to modulate a carrier of frequency 10 MHz and peak voltage of 10V. Determine

(a) Modulation index

(b) Frequency of LSB and USB

Gujarat Board- March, 2019

167. What are the essential elements of communication system ? Explain briefly with block diagram.

Jharkhand Board-2019

168. Write notes on the following (any two)

(i) FAX;

(ii) Optical detector;

(iii) Diode LASER;

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(iv) Difference between amplitude modulation and frequency modulation.

(Short answer Type Questions) (5 marks each)

MP Board-2012

167. Differentiate between amplitude modulation and frequency modulation (any four).

MP Board-2014

168. What are analog and digital signals? Explain with diagrams.

MP Board-2014

169. Establish relation $d = \sqrt{2hR}$ between height h of the TV antenna and distance d upto which TV signal can be transmitted, where R Radius of earth.

MP Board-2014

170. What is FAX machine? Draw it's block diagram and explain it's working.

MP Board-2015

171. What is MODEM? Draw it's block diagram and explain it's working.

MP Board-2015

172. What is communication system? What are main parts of it, explain with block diagram.

MP Board-2017

173. What are carrier waves? Why do we need the carrier waves of high frequency for distant communication?

MP Board-2018

174. Derive an expression for the height of the antenna required to transmit the television signal to a distance d on the earth surface.

MP Board-2018

175. The height of T.V. antenna is h. Derive formula mathematically upto how much area signal is transmitted.

Chhattisgarh Board-2023

176. What is Modulation? Why modulation is needed to send message signal?

Chhattisgarh Board-2022, 2019

177. Describe the exeriment to compare the magnetic moments of two bar magnets, using deflection magnetometer by deflection method in tan B position under the following heads :

(i) Labelled diagram

(ii) Derivation of formula

(iii) Two precautions

Chhattisgarh Board-2018

178. What is communication system? Describe its main parts.

(OR)

What is modulation? Describe its types.

Chhattisgarh Board-2018

179. State two reasons why it is not practical to transmit audio-signals to long distances. Write one advantage and one disadvantage of each of (a) amplitude modulation and (b) frequency modulation of radio waves.

NIOS-2012

180. What is modulation? Why is it necessarily needed? Name the four methods of modulation.

NIOS-2013

181. Draw block diagrams for (a) basic analog transmitter and (b) practical AM transmitter. Which type of modulation is used in the TV transmission for (i) audio and (ii) video?

NIOS-2015

182. What is the process of modulation? Draw block diagram of a basic radio transmitter and a radio receiver.

NIOS-2016

183. What are coaxial cables? Where are they normally used? What is their maximum range?

NIOS-2016

184. Explain the modulation process. Determine all frequencies present in the following modulated wave :

$V = 30\ (1 + 0.2 \cos 1250t + 0.1 \cos 3000\ t) \cos 10^7 t$

UP Board-2019

185. (a) What is amplitude modulation? Draw a diagram showing an amplitude modulated wave obtained by modulation of a carrier sinusoidal wave on a modulating signal.

(b) Define the terms

(i) modulation index, and

(ii) side bands. Mention the significance of side bands.

CBSE-2019

186. (a) What do you mean by bandwidth of a signal ? Give its importance.

(b) Differentiate between Analog and digital communication.

(c) Write the functions of transducer and repeaters.

CBSE-2019

187. Write the relation between the height of a TV antenna and the maximum range up to which signals transmitted by the antenna can be received. How is this expression modified in the case of line of sight communication by space waves? In which range of frequencies, is this mode of communication used?

CBSE-2019

188. A signal of low frequency f_m is to be transmitted using a carrier wave of frequency f_c. Derive the expression for the amplitude

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modulated wave and deduce expression for the lower and upper sidebands produced. Hence, obtain the expression for modulation index.

CBSE-2019

189. (a) If A and B represent the maximum and minimum amplitudes of an amplitude modulated wave, write the expression for the modulation index in terms of A & B.
(b) A message signal of frequency 2 kHz and peak voltage 10 V is used to modulate a carrier of frequency 2 MHz peak voltage of 15 V. Calculate the modulation index. Why the modulation index is generally kept less than one?

CBSE-2019

190. What is space wave propagation ? Give two examples of communication system which use space wave mode.

J&K Board-2020

191. Explain what is GPS (Global positioning system).

Odisha Board-2023

192. What is modulation? Write the block diagram of the receiver.

Karnataka Board-March, 2019

193. Mention the types of transmission media.

Karnataka Board-March, 2016

194. What is the function of 'receiver' in communication system? Draw the block diagram of AM – receiver.

Karnataka Board-July, 2018

195. What is the basic difference between amplitude modulation and frequency modulation? Discuss the role of ionosphere in radio-wave communication.

Assam Board-2014

196. What is demodulation? Why is satellite communication necessary for TV signals? What is a nibble?

Assam Board-2014

197. What is modulation index? A message signal of frequency 10 KHz and peak voltage 10 volts is used to modulate a carrier wave of frequency 1MHz and peak voltage 20volts. Determine its modulation index.

Assam Board-2013

198. Why is modulation necessary? What is amplitude modulation? Draw a block diagram of a simple modulator circuit for obtaining A.M. signal.

Assam Board-2013

199. What are sidebands of an AM wave? Compare AM with FM wave.

Assam Board-2015

200. What is digital communication? Mention two advantages of digital communication.

Assam Board-2015

201. What percentage of power of AM wave is carried by the side bands for modulation index m = 1?

Assam Board-2015

202. In the broadcast of communication modulation is necessary.
(a) What do you mean by modulation?
(b) Explain any two reason why modulation is necessary?

Kerala Board-2020

203. Various propagation modes are used in communication
(a) Mention two communication systems that uses space wave propagation.
(b) Why modulation is necessary in communication?
(c) If a signal of frequency W_s is used to modulate a carrier wave of frequency W_c which are the frequencies contained in the modulated signal other then W_c ?

Kerala Board-2013

204. A carrier wave of peak voltage 12 Volt is used to transmit a message signal. Find the peak value of the voltage of the modulating signal in order to have a modulation index of 75%

(Score : 2)

Kerala Board-2017

205. In electromagnetic spectra, the wave length and frequencies are inversely related. A radio can tune in to any station in the 7.5 MHz to 12 MHz band. Determine the corresponding wave length band.

Kerala Board-2014

206. What is demodulation? Draw a circuit for using a junction diode as a demodulator. Why is demodulation necessary?

Meghalaya Board-2018

207. (a) What is amplitude modulation?
(b) Name the different types of wave propagation.

Meghalaya Board-2018

208. The height of a TV antenna from the ground is 245 m. Find the coverage area of the TV signals (Radius of the earth = 6.4×10^6 m)

Meghalaya Board-2015

209. What is demodulation? Why is demodulation necessary?

Meghalaya Board-2015

210. What is modulation factor? Calculate the modulation factor when amplitude is half of the carrier amplitude.

Meghalaya Board-2014

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211. Draw a block diagram of a detector for an amplitude- modulated signal.

Meghalaya Board-2014

212. Define binding energy and obtain an expression for binding energy of a satellite revolving in a circular orbit round the earth.

Maharashtra Board-2019

213. Which mode of propagation uses ionosphere to reflect the transmitted singles from the Earth? State other two modes of propagation.

Goa Board-2023

Section-D (Case-Based Questions)

214. What is modulation? With appropriate block diagram, describe frequency modulation.

Odisha Board-2022

215. What is the mode of propagation of waves having frequency range 30 MHz to 30 GHz? What would be the maximum distance of propagation between a transmitting antenna of height 45 meter and a receiver antenna of height 20 meter for satisfactory communication in Line-of-sight (LOS) mode? (Given, Radius of earth = 6.4×10^6 meter). 3

Uttarakhand Board-2019

Section-E (Long Answer)

216. Explain the function of superheterodyne AM receiver with block diagram.

Tamil Nadu Board-2018

217. With the help of a block diagram, explain the function of super heterodyne AM receiver.

Tamil Nadu Board-September, 2016

218. With the functional block diagram explain the working of a monochrome TV transmitter.

Tamil Nadu Board-March, 2016

219. Describe monochrome TV transmission with a block diagram.

Tamil Nadu Board-2015

220. Explain the principle and working of RADAR with neat block diagram.

Tamil Nadu Board-2017

221. Explain the functional block diagram of a monochrome TV receiver.

Tamil Nadu Board-2011

222. Describe the main features (height, frequency-range, etc.) of five layers of earth's atmosphere, which are considered to play important role in space communication.

NIOS-2012

223. Name the five layers of atmosphere that are considered to play main role in communication. Write the approximate height from the surface of the earth, frequency range and functions of these layers.

NIOS-2013

224. Describe the process of (a) sky wave propagation and (b) space wave propagation used in communication system. Draw the necessary diagram in each case. Mention one limitation of each.

NIOS-2014

225. Name five layers of the atmosphere and role played by them in communication. Describe ionospheric propagation with the help of a diagram.

NIOS-2015

226. (a) Name the region of the earth's atmosphere which acts as a 'radio mirror' and plays significant role in communication.

(b) Describe ground wave, sky wave and space wave propagation of radio waves mentioning (i) how waves travel in each, (ii) the suitable frequency range and (iii) merits and limitations of each.

NIOS-2016

227. Carrier wave of frequency 2×10^5 Hz and peak voltage 60 volt is modulated by audio wave $e_m = 30 \sin 2\pi \times 2500t$ volt. Find :

(i) modulation percentage

(ii) frequency of components of modulated wave

UP Board-2017

228. i) In our daily life, modulation plays an important role.

(a) Discuss the amplitude modulation.

(b) Give a block diagram of a generalized communication system.

OR

ii) (a) Describe how to detect an amplitude modulated wave.

(b) Sketch a neat diagram for a detector for AM signal.

Kerala Board-2014

229. (a) Obtain an expression for the coverage range in space wave propagation in terms of height of the antenna.

(b) What is modulation factor?

Meghalaya Board-2019

230. (a) What is sky-wave propagation? Obtain an expression for the converge range in space-wave propagation in terms of the height of the antenna.

(b) Discuss two factors responsible for the need for modulation in communication.

Meghalaya Board-2013

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